SPRING/SUMMER 2007

Harvard Medical

ALUMNI BULLETIN

DESIGN FOR HEALING

Harvard rolls out a medical curriculum for the twenty-first century.

LUMINARY

1968

As dean of Harvard Medical School from 1965 to 1977, Robert Ebert championed numerous initiatives that today help define the very character of the School. He increased recruitment and enrollment of minority students, established affiliations between HMS teaching hospitals and neighborhood health centers, and created the Division of Health Sciences and Technology. In 1969, Ebert also founded Harvard Community Health Plan, the nation's first academic health maintenance organization.

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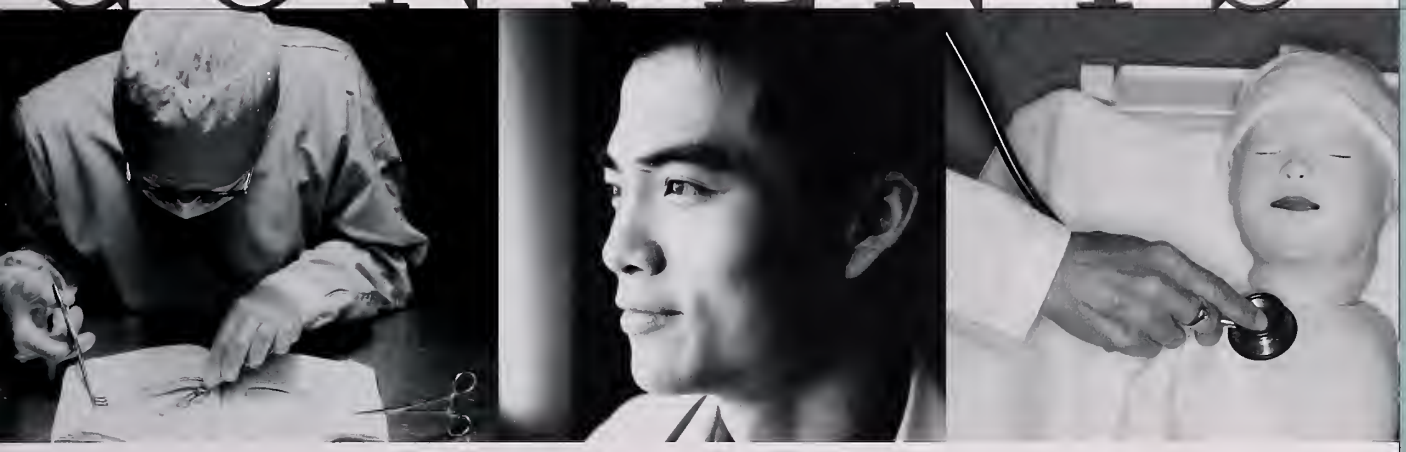

TRIBUTE TO JOSEPH MARTIN

DEPARTMENTS

SPECIAL REPORT: DESIGN FOR HEALING

FEATURES

Cover photograph: Katherine Lambert

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In This Issue

As I write, our sister institution the Law School is demolishing a pleasant modernist parking garage, which will be replaced with a larger postmodernist classroom building. In its time, the parking garage supplanted an amiable row of Victorian brick houses. Meanwhile, the Medical School is now in the terminal phase of replacing its latest, rather likable, curriculum with a new edifice of knowledge, practice, and inquiry.

What I have found unnerving about the events at both schools is that I can clearly recall what came before the structures, architectural or curricular, that are now being replaced, and for a while I was an active participant in the latter. Where is Harvard's stuffy conservatism when you reach an age at which you might find it consoling? Granted the Quad is still standing and is unlikely to be replaced by anything more adapted to modern needs, and some of the School's faculty members appear nearly as indestructible. Yet at times like this we are reminded how much innovation there is at HMS, and that several innovations in succession may fit quite handily into a single living memory.

Apart from the fact that it induces one to view oneself historically, the latest set of changes appears to be good for students, who all too soon will find themselves on the slippery slopes of social and economic change as they try to live up to their concepts of excellence. Coping with the institutional context of medicine has become devilishly challenging and sometimes disheartening. What we can hope for from the new curriculum is that students will leave it not only with a better understanding of the institutions that provide care but also with the ideals and energy to begin tearing them apart and rebuilding them in ways that are sufficiently radical to be worthwhile.

In this spirit, and this issue, we inaugurate a department that we call "The Visible Hand," a column about the political and economic context that shapes medicine in the United States. Our first columnist is Timothy Ferris '92, who takes on a topic that is fundamental to academic medicine: how the government solicits and reviews research proposals. Tim is a member of our Editorial Board; in one of his day jobs he studies the ways in which quality of care can be measured and enhanced.

William Ira Bennett

GRACE AND FAVOR

Special thanks to the *Bulletin* for the wonderful report, Sparks of Inspiration, in the Autumn 2006 issue. I enjoyed all seven articles and was particularly struck by the fact that three of them were about HMS alumni—Jim Kim '91, Ernest Darkoh '98, and Catherine Wilfert '62—who have devoted themselves to bringing health care to some of the world's most neglected people. While it is well known that many HMS graduates do outstanding laboratory and clinical research, I found it particularly inspiring to learn about some who have made outstanding achievements in bringing the products of medical advances to needy populations around the world. Because of their brilliance, courage, and persistence, all seven of the people profiled are truly heroic.

CAVIN P. LEEMAN '59
NEW YORK, NEW YORK

Guiding Light

Thanks so much for your case histories of HMS alumni and faculty members who have been inspired and have carried that inspiration to create great deeds. I have long admired Ernest Darkoh '98, Judah Folkman '57, and Catherine Wilfert '62, and I wanted to add a personal comment to Dr. Wilfert's sketch.

In the last analysis, we professors will be remembered not so much by our papers in the *New England Journal of Medicine* but by our "children" and "grandchildren," those whom we have trained and inspired. After devoting 19 years to HIV care, training, and research, I approached Cathy in 2000 about working in Africa. She took me under her wing and helped me obtain initial funding to implement a program to prevent mother-to-child-transmission of HIV in Malawi. That program has since become one of the largest in Africa.

Using Cathy's philosophy of viewing the big picture and the details simultaneously, doing hands-on work, starting small, and conducting research to get necessary answers, I have subsequently mentored others—her "grandchildren"—in both South Africa and Malawi. Her indomitable spirit, fierce work ethic, and generosity are legendary. I am so fortunate to know her and to count her as a friend.

CHARLES VAN DER HORST '78
CHAPEL HILL, NORTH CAROLINA

Glimmer of Hope

I enjoyed your article in the *Bulletin* on Judah Folkman '57. I had known about his work on angiogenesis for a long time, but not its use in macular degeneration. I have been surprised at the number of people I know who have macular degeneration. Several of my closest friends are blind because of it. I hope Dr. Folkman's discovery proves to be a real solution.

ROWLAND FRENCH '43B
EASTPORT, MAINE

Quiz Kid

I was startled and delighted to see the Endnotes quiz in the Autumn 2006 issue of the *Bulletin*, but I was dismayed by your failure to give it proper attribution. The fake quiz was authored by David Sachar '63, who eventually became the first Dr. Burrill B. Crohn Professor of Medicine at the Mount Sinai School of Medicine.

David authored the quiz as a response to the pathophysiology faculty's propensity to greet arriving students with quizzes on the chairs in one of the auditoriums. Young faculty members harassed medical students by trying out their newfound multiple-choice test-writing skills, often with mangled results. An astonishing number of the real tests were incomprehensible.

This particular "examination" was distributed on the chairs in one of the auditoriums, not in Vanderbilt Hall, as the *Bulletin* stated. I know, because Henry Keutmann '63 and I helped David distribute it early one morning in the short window between the opening and the filling of the room. The three of us were thrilled to find that many of our classmates actually tried to take the exam and did not realize it was fake until they had perused several questions. I have an original in hand (not yet for sale on eBay); it is dated January 14, 1961. The exam consisted of three single-spaced pages, and it was a delightful spoof from beginning to end.

Your excerpt included some of the more interesting questions but omitted my personal favorites:

Which of the following is least unlikely not to occur:

a. The failure of choriocarcinoma to metastasize to an organ other than the lung
b. Death of a fetus without either abortion nor hydatidiform change, but not without both
c. Neither of the above

Carcinoma in situ of the cervix develops into invasive carcinoma:

a. Not usually never
b. Never in all cases, but often in many
c. Not necessarily always, but rarely in most
d. Usually, in rare cases especially
e. Generally, but not invariably never

I will be glad to share the entire examination with anyone who wishes to contact me at lockshinm@hss.edu.

MICHAEL D. LOCKSHIN '63
NEW YORK, NEW YORK

Shedding New Light

One letter to the editor in the Autumn 2006 issue of the *Bulletin*, titled "Through a Glass Darkly," prompted me to respond. The photo of a man looking through a microscope is not a joke. In those days (and likely today, as well) the microscope was turned as shown in the photo whenever one looked at objects under very low magnification to make it easier to maneuver a slide, such as one with a paramecium in a culture solution. The man in the photo seems to be looking at a raised object rather than at a standard slide and is obviously not using high-power magnification. He also has his hand near the light source to change its intensity or reflection angle. My answer, then, to the query "Is this a real photo or a poorly contrived picture?" is that it's a true presentation of a knowledgeable observer using an old-style light microscope correctly.

ARNOLD A. LEAR '50
POTOMAC, MARYLAND

A TALE OF TWO CITATIONS

In a *New York Times* essay last December, Lisa Sanders credited Charles Dickens with the original description of what C. Sidney Burwell '19 and colleagues called alveolar hypoventilation, or Pickwickian syndrome, in a 1956 issue of the *American Journal of Medicine*. The essay reminded me of an article you ran in the Spring 2004 issue of the *Bulletin* about the Pickwickian syndrome, named for a grossly obese and somnolent boy, Joe, who fell asleep while knocking on a door in Dickens's *The Pickwick Papers*.

Burwell was a former dean of Harvard Medical School. He and his associates had been unable to find any earlier description than that by Dickens and credited H. O. Sieker, et al., with prior scientific investigation of four cases. Yet John Fothergill, a famous London physician, reported similar cases of extreme obesity and disabling somnolence in two young people, a man and a woman, in a 1776 edition of *Medical Observations and Inquiries by a Society of Physicians in London.*

ILLUSTRATION: WESLEY BEDROSIAN

How did Burwell and his colleagues miss Fothergill's paper? Medical papers are usually catalogued by title. For his title, Fothergill chose "Case of Angina Pectoris, with Remarks." The second half of this paper is the report of his two obese, somnolent patients. Only someone interested in early publications on angina pectoris—or an admirer of Fothergill—would have been likely to have discovered the second half of Fothergill's paper. Fothergill was a modest man and would not have protested the oversight. It is unlikely that Dickens was aware of Fothergill's report.

WILLIAM L. PROUDFIT '39
CLEVELAND, OHIO

Name Dropping

Now that I have completely retired, I have time to write to you about something that has been bothering me for more than 60 years.

I graduated from Harvard Medical School in 1944, on what should have been one of the happiest days of my life. It wasn't. First, my mother was sick and could not attend my graduation. My father had died in 1938. My graduating class marched in as privates and marched out as first lieutenants. I never had a chance to wear the cap and gown of a graduate of Harvard Medical School. We didn't even take the Hippocratic oath.

And then came my biggest disappointment. I received my diploma and found it was made out for Milton *Philippum* Shoob. Why did HMS have to Latinize my middle name? I should have taken care of this error immediately, but I was in a hurry to leave and start my internship. I do not use my first name, just my first initial. But there was no way I was going to write a prescription for a patient and sign it M. Philippum Shoob, MD.

When I opened my office I hung my diploma in a conspicuous place so everyone would know I was a Harvard graduate. Do you have any idea how many times I had to answer, "What's with the Philippum?" I know it is much too late to do anything about this matter but I did have to get it off my chest.

M. *PHILIP* SHOOB '44
COMMACK, NEW YORK

Editor's note: This spring, 63 years after his graduation, M. Philip Shoob received a new, corrected diploma from HMS.

Under the Skylight

WHEN JEFFREY FLIER MULLED a job offer from Harvard Medical School nearly 30 years ago, friends and colleagues weighed in: Don't do it, they said. No one ever gets promoted there.

Flier's career has laid these concerns to rest. He rose from chief of the Diabetes Unit at what is now Beth Israel Deaconess Medical Center to head of the Endocrine Division to chief academic officer and endowed professor at HMS, a trajectory that has recently culminated in his appointment as dean of the faculty of medicine. When he is officially inducted in September, Flier will be the School's twenty-first dean.

He succeeds Joseph Martin, who stepped down as dean at the end of June, after a decade of distinguished service at the School.

"During the 29 years that I have pursued an extraordinarily rewarding academic life within the Harvard medical community," Flier says, "I have come to know its amazing strengths from its students to its faculty, both on the Quad and within the Harvard-affiliated hospitals and research institutions.

"This medical school is a national treasure," he says, "and while it is a humbling thought that I will now have great responsibility for maintaining and enhancing the accomplishments of HMS, this is a responsibility I accept with great optimism and excitement."

Harvard University's new president, Drew Gilpin Faust, has praised Flier for being a progressive leader, an outstanding medical educator, and an eminent scientific investigator.

BIG MAN ON CAMPUS: Jeffrey Flier, the George C. Reisman Professor of Medicine at HMS, has been named the twenty-first dean of Harvard Medical School.

PHOTO: BRUCE WAHL

As an endocrinologist and one of the nation's leading authorities on obesity and diabetes, Flier has researched the molecular mechanisms of insulin action and of insulin resistance in human disease. His laboratory was one of the first to untangle why, in a typical population of obese animals, high levels of the hormone leptin were present. This didn't jibe with the conventional wisdom of the time, which held that leptin's function was to prevent obesity. But Flier considered the possibility of leptin resistance and demonstrated that the physiological role of leptin was not to prevent obesity, but to signal to the brain that there was an inadequate supply of energy, triggering overeating and, potentially, obesity.

Flier's discovery that leptin can switch the brain from a fed to a starved

Harvard president Drew Gilpin Faust has praised Flier for being a progressive leader, an outstanding medical educator, and an eminent scientific investigator.

state led to a fundamental reshaping of the discourse on diabetes and obesity.

The author of more than 200 scholarly papers, Flier lately has focused on neuroendocrine disease, the physiologic mechanisms by which signals throughout the body communicate to the brain, and the ways in which the brain exerts influence over peripheral metabolic events. One recent paper examined the role of chemokines in recruiting macrophages, which have been implicated in the pathogenesis of insulin resistance, into fat cells.

Flier entered the field of metabolic diseases early on. After earning his medical degree from Mount Sinai School of Medicine and doing his residency in internal medicine at Mount Sinai Hospital, he spent four years as a clinical associate at the diabetes branch of the National Institutes of Health and the National Institute of Arthritis, Metabolism, and Digestive Diseases before joining HMS in 1978.

He was promoted to full professor in 1993 and named the George C. Reisman Professor of Medicine in 1998. In 2002, Flier was named chief academic officer at Beth Israel Deaconess Medical Center, a senior position responsible for research and academic programs. There he worked with the academic department chairs to ensure quality and breadth in the center's academic programs, through which most Harvard medical students pass. He also served as the formal liaison to the School, sitting on the Council of Academic Deans.

Flier has most recently been active in shaping medical education through his stewardship of HMS teaching programs at Beth Israel Deaconess Medical Center and his involvement with the curriculum committee for the Harvard–MIT Health Sciences and Technology program.

Flier has also been closely involved in recent discussions of the future of Harvard-wide science as a founding member of the Harvard University Science and Engineering Committee and through his service on the University Planning Committee for Science and Engineering.

"This is an exciting time for Harvard medicine," says Harvard University Provost Steven Hyman '80, "as transformative developments in biomedical research greatly expand our opportunities to understand disease and improve human health. At such a moment, we are very fortunate to have someone with Jeff Flier's broad leadership experience in medical research and education, deep familiarity with Harvard, and strong sense of future possibilities to help Harvard Medical School rise to the challenges ahead." ■

PHOTO: JEFF THIEBAUTH

Route '66

BARBARA MCNEIL BECAME ACTING DEAN of Harvard Medical School on July 1. McNeil, a member of the Class of 1966, is the Ridley Watts Professor of Health Care Policy at HMS, chair of the School's Department of Health Care Policy, and HMS professor of radiology at Brigham and Women's Hospital.

"Barbara has a proven track record as a leader in our medical community," says Joseph Martin, who recently stepped down after a decade as dean of the School. "HMS is fortunate to be able to turn to her in this time of transition."

Under McNeil's stewardship, the Department of Health Care Policy has become a national leader in health services research and in the scholarly areas on the boundary between clinical medicine and behavioral science. McNeil has earned national and international recognition for her seminal work bringing the methods of decision science and technology assessment into the health care arena. She is also renowned for her academic contributions describing the relationships among clinical services, quality of care, and patient outcomes.

"Harvard Medical School is an exceptional institution and has made tremendous contributions in research and education—and, with its teaching hospitals, in patient care as well," says McNeil. "I am pleased to serve in this period of transition." ■

Win, Place, Show

Once again, Harvard Medical School was the horse to bet on in the race for number one in *U.S. News & World Report*'s annual listing of the nation's exceptional graduate schools, garnering an overall perfect score and placing first among the country's medical schools in the research category. HMS also earned top marks in women's health; second place in the fields of AIDS, pediatrics, and internal medicine; and third place in drug and alcohol abuse treatment.

Pulling Rank

Harvard-affiliated hospitals have again placed high in *U.S. News & World Report*'s annual rankings of the nation's nearly 5,500 medical centers. Of the 173 hospitals that made it into the rankings, 18 scored high in at least six specialties, qualifying for honor-roll status. Of those star achievers, Massachusetts General Hospital ranked fifth and Brigham and Women's Hospital tenth.

Harvard hospitals also received recognition for outstanding work in 16 specialties. Massachusetts General Hospital's rankings included first in psychiatry; second in endocrinology; third in orthopedics; fourth in digestive disorders, geriatrics, kidney disease, neurology and neurosurgery, and respiratory diseases; fifth in heart and heart surgery; seventh in rheumatology; tenth in cancer; and eleventh in urology.

Brigham and Women's Hospital rankings included first in kidney disease; second in gynecology; third in heart and heart surgery; sixth in rheumatology; ninth in endocrinology; tenth in digestive disorders; and eleventh in orthopedics. Among other Harvard-affiliates, Beth Israel Deaconess Medical Center's placements included tenth in geriatrics; twelfth, with the Joslin Clinic, in endocrinology; and fourteenth in digestive disorders.

Other Harvard hospitals in the placements included McLean Hospital, ranked third in psychiatry; Massachusetts Eye and Ear Infirmary at fourth for both ophthalmology and ear, nose, and throat; Dana-Farber Cancer Institute, ranked fifth in cancer; and Spaulding Rehabilitation Hospital, ranked eighth in rehabilitation medicine. Children's Hospital, which has placed first or second in pediatrics for the past 17 years running, has not yet received its ranking, as *U.S. News & World Report* is revamping its guidelines for pediatrics.

Budding Endeavor

A NEW DEPARTMENT HAS BEEN FORMED AT HARVARD, THE FIRST ACADEMIC department in the institution's 371-year history to be based in more than one of the University's schools. The Department of Developmental and Regenerative Biology will splice researchers from Harvard Medical School and the Faculty of Arts and Sciences (FAS) to take advantage of opportunities in multidisciplinary areas of science and engineering.

"Over the past decade the School has developed many strong collaborations with our hospitals and with other Harvard faculties," says Joseph Martin, who recently stepped down as dean of HMS. "But this new initiative, with its status as a full-fledged department, will have academic opportunities that are unprecedented in terms of appointments and the options for creating learning opportunities." The department will be housed in Harvard's new science complex in Allston, which is slated for completion in two years.

PHOTO: ROGER RESSMEYER/SCIENCE FACTION/GETTY IMAGES

To integrate the often disparate bodies of scientific research within FAS, HMS, and the School's affiliated hospitals, the department will have two chairs—David Scadden, the HMS Gerald and Darlene Jordan Professor of Medicine at Massachusetts General Hospital, and Doug Melton, the Cabot Professor of the Natural Sciences in FAS. Scadden and Melton, founding co-directors of the Harvard Stem Cell Institute, stress that the new academic department will complement and strengthen, rather than supplant, that institute.

"Creating this department clearly signals that Harvard is going to be bold and is going to lead in forging new connections between basic science and human health," says Scadden. "It will create exciting and unique educational opportunities for our students at all levels by bringing these worlds together. Placing it in Allston will create an organizing hub to bring together the medical and Cambridge campuses. It is an experiment. If successful, it may transform the University." ■

Sin Rewarded

The *Bulletin* recently received two national awards from the Council for Advancement and Support of Education, or CASE: a grand gold medal for its special report on the seven deadly sins, and a silver medal in the special constituency magazines category. The *Bulletin* also won a Clarion Award in the category of Best Overall External Magazine, Circulation of 100,000 or less. ■

Near Landings

ON THE 55TH ANNUAL MATCH DAY, 180 HMS STUDENTS TORE OPEN THEIR ENVELOPES AND learned where they would be spending their residencies. More than half of the HMS grads will remain in Massachusetts. Seven percent of the class will head for New York City and 18 percent for cities in California. The most popular specialty is internal medicine, followed by pediatrics and emergency medicine. Specialties that saw an increase in the number of matches compared to last year include anesthesiology, radiology, and neurology, while pediatrics, emergency medicine, and family practice each had decreases.

PHOTOS FOR THIS SPREAD: LIZA GREEN

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John Ng
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Ryan Lokken
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Agents of Change

THE PAST YEAR HAS BEEN ONE OF CONTINUING TRANSITION at Harvard Medical School. The most momentous change was Joseph Martin's stepping down as dean after leading the School through ten years of remarkable, multidimensional growth. In June, I heard Joe describe essential quotients for effective leadership, including intelligence, empathy, humor, optimism, generosity, and wisdom. On Alumni Day, I had the pleasure of thanking Joe for the application of those quotients in his own leadership, for his guidance of the School, and for his warm embrace of HMS alumni.

This past year also marked the launch of the School's long-awaited, carefully crafted new curriculum under the leadership of Jules Dienstag, the dean for medical education at HMS. The changes, which promise more structure and continuity of contact between students and faculty in the clinical years, have already generated enthusiastic responses.

Service on the Council has reinforced my appreciation of the uniqueness of HMS, the talents of its faculty and students, and the wisdom of its alumni.

The Alumni Council has undergone changes of its own. During the past several years, it has evolved into a fully engaged committee actively seeking to strengthen the School and benefit its alumni and students. With Joe's encouragement, for example, we took on the problem of student debt. We facilitated an increase in the family income cutoff below which parental contributions to tuition are not required. The increased number of alumni donating to the Alumni Fund has enabled the School to sustain this cutoff. The Council remains committed to easing the burden of student debt.

After extensive discussions with Sanjiv Chopra, faculty dean for continuing education, the Council voted to establish automatic membership for all alumni in the HMS Postgraduate Medical Association. This membership will extend such benefits as access to online offerings and other curricular content of the School's continuing medical education program, as well as invitations to regional Pri-Med courses, Harvard's continuing education program for primary care physicians. A future issue of the *Bulletin* will provide details.

The Council has supported the integration of an electronic alumni directory with our new Alumni Association website. William Chin '72 and Steven Weinberger '73, the Council's incoming president and president-elect, respectively, will work to link alumni to the School, to one another, and to students who have expressed an interest in alumni as mentors. We encourage all alumni to take part in our new virtual community by visiting www.hms.harvard.edu/alumni and clicking on post.harvard.

Transition is also under way at the Alumni Fund. Daniel Federman '53, who has been serving as the fund's interim chair, has reassessed the fund's goals and operation and the role of class agents. His report to the Council cited the needs for increased fundraising to keep pace with efforts to allay student debt, a greater professionalization of the fund's administration, and the establishment of renewable terms for class agents rather than a continued reliance on the current lifelong ones attached to these demanding positions. A committee has begun the search for a permanent director of the fund. Chaired by George Thibault '69, director of alumni relations, the committee includes Dan Federman; Bill Chin; Mary Moran Perry, executive director of alumni relations; and me. Please send nominations to mary_perry@hms.harvard.edu.

Another transition took place recently, one we all regret: Jean Hurd, who has guided so many HMS classes through the reunion planning process and has served the Council so faithfully, has retired. We thank Jean for her superb service and wish her well.

It has been my privilege and honor to serve as your president for the past year. Even though I've been a member of the HMS faculty for nearly four decades, service on the Council has rekindled my relationship to the School and has reinforced my appreciation of the uniqueness of HMS, the talents of its faculty and students, and the wisdom of its alumni.

The Council is committed to serving the interests of the School and its students and alumni. Let us hear from you. ■

A. W. Karchmer '64 is HMS professor of medicine and chief of the Division of Infectious Disease at the Beth Israel Deaconess Medical Center in Boston. He can be reached at akarchme@bidmc.harvard.edu.

PHOTO: KRIS SNIBBE/HARVARD UNIVERSITY NEWS OFFICE

The Paper Trail

As I took an aisle seat on the Washington, DC–bound plane, I glanced at the man seated by the window. His disheveled clothes ruled out lobbyist, and his tired eyes suggested he had been laboring through the papers stacked on the seat between us. But the heavily marked-up pages in his hand gave him away.

A grant application for the National Institutes of Health is unmistakable even from a distance: single-spaced text, half-inch margins, principal investigator's name in the upper right-hand corner of each page. Like me, my fellow traveler was headed to the capital to participate in a study section. I placed my own stack of applications on the seat next to his. He groaned and flashed me an empathetic smile.

I was traveling to my final scientific review committee meeting after three years of service. Odd as it may seem, I have had few experiences that have created as much anxiety and, well, passion.

Last year, through the NIH, the federal government dispensed $21 billion in biomedical research grants. How does the nation decide what science and which scientists are worth funding? It works like this: The NIH determines what general areas of research show the most promise and issues requests for proposals or applications. Scientists then spend several months crafting documents that often run to 50 pages.

In 2006, the NIH received more than 45,000 of these proposals. If stacked, those half-inch-thick applications would exceed the height of what was until recently the world's tallest building, which juts a third of a mile into the Taipei sky. Each must be reviewed. That's where my flying companion and I came in. He was headed to a study section for the National Heart, Lung, and Blood Institute; I was headed to the comparatively small Agency for Healthcare Research and Quality. That same year, more than 1,500 study sections convened an estimated 18,000 scientists to review applications for federal funding. Study sections are assigned a topic area and typically meet several times a year for two or three days.

Reaching for the Stars

The bottom line for any grant application is the score, which ranges from 100 (perfect) to 500 (absurd). Although scores don't determine funding, they are critical. Every application is first reviewed and scored by at least three members of the study section and then by the group as a whole, which entails assessing the scientific worth of some of the densest and most specialized prose on the planet. This is not light reading, and it's work that tends to get done on nights and weekends. My kids know when it is grant-review season and are not amused.

Grant applications are highly structured sales pitches. Investigators need to prove they know the science that preceded theirs—how they stand on the shoulders of giants—and persuade reviewers of the importance of their topic. To do this they may cite more than a hundred references (a good salesperson wouldn't want to miss citing a potential reviewer's work) and end with an autobiographical puff piece.

The methods section provides a step-by-step walk through the experiments and their analyses. It can sometimes be tricky for the reviewers to figure out whether—to paraphrase Victor Hugo—the picture painted in this section is a view of the stars in heaven or just the radiations created by the impressions of a duck's foot pressed in mud.

Strike Three

My traveling companion and I employed a similar approach to scoring. After finishing our first reading, we would start at the end, the anticipated result, and work backward through the methods to locate logical flaws undermining the conclusion. The process was iterative: checking back and forth through the application to ensure that each assertion was valid, each step followed from the previous step, and each calculation was sound.

Why the attention to detail? The simple—and official—answer is that every application deserves a thorough review. But the reviewer also gets caught up in a social system that has the potential to unmask a scientist's most prized personal quality: his or her intellect.

Reviewers must justify their scores in front of all study section members. This face-to-face exchange is an essential aspect of the process. Giving an application a poor score is like making a diagnosis of exclusion. You face three possibilities: you were half asleep and simply need to try again; the writing is unclear but the application is fundamentally sound; or your impression of the application's limitations is correct. For each such grant you need to rule out the first two possibilities well enough to feel comfortable with reaching the third. At some point you must make your call. Like an umpire you call it as you see it—but you call it to a room full of umpires.

Most applications have small flaws, and seasoned reviewers demonstrate their skills by finding mismatches between the budget and the methods, pointing out incorrect citations, or even detecting small errors in the statistical approach. Although these weaknesses may hurt an application's score, they are generally not significant. On the other hand, a reviewer does not want to be caught missing a "fatal flaw"—the informal term describing an error in logic or approach that fundamentally and irreparably invalidates that proposal. A

PHOTO: RICK BARRENTINE/CORBIS

scientist's failure to detect a fatal flaw is the equivalent of a physician's missed diagnosis.

A Roadmap Less Traveled

The process has limitations, of course. First, the effort and cost it takes to recruit, manage, and sponsor a study section are substantial, even with electronic review, and having hundreds of senior scientists read through stacks of applications when only a few will be funded may not be the best use of their time. Second, problems of groupthink can arise in the meetings, favoring fairly conservative approaches over truly innovative work. Young scientists without track records may not get the same nod as established investigators with big reputations. Forceful personalities can sway the group (think *12 Angry Men*). Moreover, some grants end up in the hands of the wrong reviewers. Finally, not every reviewer pores over each detail the way my fellow traveler clearly had.

NIH managers try to minimize these risks by carefully selecting and screening chairs and reviewers. The rules governing conflicts and disclosures are strict and vigorously enforced. Nonetheless, as with any enterprise based on human interactions, problems—and mistakes—inevitably occur.

Is this cumbersome but painstaking process the best way to decide how to fund science? The NIH Roadmap for Medical Research has already begun to modify it. Recognizing that certain urgent questions, such as figuring out which genes are involved in cancer, are too pressing to be left to the marketplace of ideas, the NIH is becoming more directive about what it wants to fund and about how the funding will be used. Study sections still review grant applications, but applicants no longer have to justify the importance of the questions to be answered—NIH officials have already decided that.

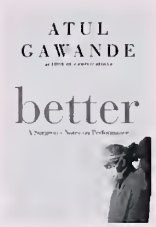
Yet the old, flawed process has produced extraordinary scientific wealth. A more "efficient" process, given the big bucks and high stakes, might be vulnerable to insidious and destructive distortions. The more prescriptive approach contained in the NIH Roadmap may, for example, be more susceptible to political winds. How we make choices about what science should be funded will continue to evolve, and almost certainly no single best method exists. Winston Churchill's maxim about democracy might apply here: Study sections are the worst way to fund science, except for all the others.

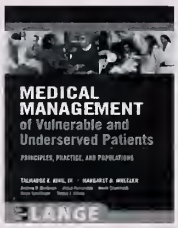
The Agony and the Ecstasy

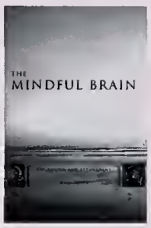
Looking through my stack of applications on the flight to Washington, I realized how important this experience has been to me. This was tough, often mind-numbing work, yet rich with reward: I encountered many new facts and ideas and developed a deep appreciation for the investigators who labored to produce the applications. And although my fellow reviewers and I didn't always agree, our meetings cemented relationships based on a shared passion—in our case, improving the delivery of health care—and a shared willingness to bare our intellectual acumen to each other. For a scientist, that's a bit like taking your clothes off in public. And I felt humbled by my colleagues' extraordinary displays of brainpower.

In the end, though, the study-section process is about helping to move that one terrific grant, the one that will make a difference, to the front of the line. It is the wheel that advances science, that makes possible the discovery, for example, of the gene that controls insulin secretion or causes prostate cancer. During my tenure on a study section I was fortunate enough to review several truly extraordinary grants, and I am proud to have played a small part in their success. ■

Timothy Ferris '92 is an assistant professor of medicine and pediatrics at Harvard Medical School, medical director of the Massachusetts General Physicians Organization, and a senior scientist at the Institute for Health Policy at Massachusetts General Hospital.







The Enemy

By Rafael Campo '92 *(Duke University Press, 2007)*

In his fifth collection of poetry, Campo writes of a country endlessly at war, not only against evildoers abroad but also with its own troubled conscience. Love, hope, and transformation are persistent themes in these 49 poems, which range in form from the 17-syllable haiku to the line-repeating pantoum.

Better

A Surgeon's Notes on Performance, by Atul Gawande '94 *(Metropolitan Books, 2007)*

Gawande is concerned with performance, particularly with the gap between what doctors aspire to do and what they accomplish—and how that gap might be closed. He finds his answers in the important human qualities of diligence, moral clarity, and the capacity for change. He seeks lessons in the contrasts between practice and intention in battlefield tents, malpractice courtrooms, and even the contentious history of hand washing.

The Power of the Bite

Impressive Weight Loss, One Bite at a Time, by Michael A. Nierenberg '71 *(iUniverse, 2006)*

This quick read will inspire people who approach weight loss with low-cal intentions yet high-cal hors d'oeuvres. The author promotes lifestyle changes rather than dieting. Cut just 120 calories per day, he says, and lose four ounces per week, for a loss of more than 25 pounds over two years; add exercise and hasten the loss. He provides tricks to trim calories—such as replacing the oil at the top of a salad dressing bottle with balsamic vinegar—and charts to guide meal choices.

Medical Management of Vulnerable and Underserved Patients

Principles, Practice, and Populations, edited by Talmadge E. King, Jr. '74 and Margaret B. Wheeler *(McGraw-Hill Medical, 2007)*

Working with patients whose barriers to health care include a lack of insurance, inadequate access to transportation, or poor English language skills often requires physicians to take novel approaches. This book offers suggestions for navigating cross-cultural communication, locating valuable community resources for patients, and promoting compliance. One tip, for example, recommends creating a visual, weeklong medication schedule for any patient who does not understand English well.

The Mindful Brain

Reflection and Attunement in the Cultivation of Well-Being, by Daniel J. Siegel '83 *(Norton, 2007)*

Siegel, a neurobiologist, discusses how being mindfully aware—fully present in the moment—not only keeps us attentive to the richness of our experiences but also leads to positive changes in our physiology and interpersonal relationships. Siegel says attunement can lead to improved immune function, a sense of well-being, an increased connection to loved ones, and neural integration, which contributes to mental flexibility and self-understanding.

The Beautiful Skin Workout

Eight Weeks to the Smoothest, Healthiest Skin of Your Life, by Michelle Copeland '77 with Megan Deem *(Griffin, 2007)*

The skin reveals all our secrets, says Copeland, particularly our sun-worshipping, latte-slurping vices. But she has a cure to return all that alligator skin to its former creamy self. Her eight-week regimen includes cleansing, exfoliating, slathering on the right lotions, eating foods rich in omega-3s and antioxidants, and exercising.

Treatment Kind and Fair

Letters to a Young Doctor, by Perri Klass '86 *(Perseus Books, 2007)*

The young doctor to whom the ten letters in this book are written is the author's son, Orlando. He has decided to follow in his mother's footsteps, and Klass has wisdom to impart. She considers the challenges of entering medicine—such as palpating a patient's "squishier parts" for the first time—and the changes resulting from technology and legislation, such as the blessings and hardships of a mandated 80-hour workweek during residency.

To Die Well

Your Right to Comfort, Calm, and Choice in the Last Days of Life, by Sidney Wanzer, MD and Joseph Glenmullen '84 *(Da Capo Press, 2007)*

YOUR GOOD DEATH—IN WHICH ALL FLOWS TOWARD A GENTLE end—will require clarity of thought and strategies laid out long before circumstances necessitate them. Resist the hope that this will happen without active intervention, warns Sidney Wanzer, writing in collaboration with Joseph Glenmullen '84. No one will ever care as much about how you die as you will. Maintain vigilant control. *You* are at stake.

To Die Well takes only a few hours to read—but life-changing literature does not need to be encyclopedic. "I think every dying patient and his or her family should consider drawing up detailed instructions for the final days," Wanzer writes. Then he helps us to do so.

Clearly defined goals are the most important part of instruction. The first comes when a patient opts for comfort care instead of aggressive treatment. All the symptoms of dying—lethargy, weakness, anorexia—must suddenly be separated from symptoms of distress, such as anxiety, dyspnea, and pain. The former are to be respected, the latter managed. It means prescribing addictive medications without fear of causing addiction; "the proper dose of any analgesic…is the amount necessary to relieve pain." It also means that treatments can be refused or even discontinued. This is a concept that undermines our Newtonian expectation that bodies in motion will remain so. Comfort care means changing speed and course.

Through changes of speed and course, interventions that formerly were accepted now prolong the dying process. That seems simple enough; palliative care is no longer seen as an eccentric field. Yet, as Wanzer writes, "it is amazing how many people feel it is somehow improper to stop a treatment that has already been started." "Treatment" may include food and water. In one of many startling educational moments, the author disposes of the idea that withholding fluids is cruel, pointing out that dying patients do not feel extreme thirst and distress because "the dying process impose[s] a form of autosedation in which all senses are dulled, including the sensation of thirst." He adds, with a logic one cannot deny, that giving fluids to a patient who does not want them anymore "could [even] be considered battery."

So ends the less controversial part of the book. Next Wanzer looks the devil in the eye: When should the clearly defined goal be to hasten death? By the time this question arises, "even meticulously rendered maximum comfort care is not enough to control a dying person's intolerable suffering." Pain control, consultations, and efforts to diagnose depression or other reversible conditions have all occurred, yet still "the situation declares itself [as] undeniable." Deliberately hastening death under these circumstances may seem so sensible that it's almost difficult to understand what all the fuss is about.

The fuss, for those who will make it, comes after reading the chapters that follow. Wanzer is very practical. He warns that guns and carbon monoxide are to be avoided; taking nine to ten grams of barbiturates is a much more reliable strategy, as is using one to two tanks of 100-percent helium.

In simple words, Wanzer answers the questions we might fear to ask in the litigious light of day ("if a barbiturate is stored in a dry environment at room temperature (not in the refrigerator) it probably retains potency for a few years (maybe five or seven)." What a relief to know this. It is as if he were sitting in a sunlit kitchen with us, sharing tea and tips for keeping yeast fresh. There is nothing illicit in the conversation he holds, no hysterics or drama. His voice is full of good manners and deep experience; he accepts another cup of tea—thank you, no more cake—and continues.

Here is a book so dense with different kinds of wisdom that one chapter replicates the technical documents you need to make your wishes clear, while another discusses behavior in the presence of the dying. "Sit close with your head on a level with the patient's," this wonderful doctor recommends, "speak of the good things he or she has meant to you, and you will do fine and will be a comfort."

We are interested mostly in our own good deaths, of course, and Wanzer ends with a list of "Essentials for Staying in Control." From a medical man, some of the advice is chilling; for instance, "avoid transfer to the hospital unless it is clearly necessary for the control of symptoms." Even doctors don't want to die badly, and the very specialists who run the system also fear being at its mercy. Until physician-assisted death is legalized across the country, brave doctors (Wanzer is a leader among them) will be left searching for ways to protect their patients from their profession. ■

Elissa Ely '88 is a psychiatrist at the Massachusetts Mental Health Center.

IMAGE DIGITAL VISION/GETTY IMAGES

Served with a Twist

At first the scene is a familiar one: A man stands in front of a mirror, lathers cream on his face, and proceeds to shave—but with a rolling pin. What happens in our brains when what we hear or see doesn't jibe with what we expect?

Over the past eight years, researchers at Massachusetts General Hospital have been attempting to answer this question by analyzing study participants' reactions to all manner of verbal and visual surprise endings—sentences with unexpected or outlandish words and video clips with anomalous or downright bizarre final images. Using a combination of methods that detect when and where neural activity occurs, they have been comparing how our brains react to the merely unexpected scenarios versus the wildly strange ones.

Their findings show that both types of anomalies are processed in less than a second, but more outlandish ones take a bit longer. The delay, a mere 200 milliseconds, is accompanied by brain activity similar to that which occurs when we grapple with grammatical mistakes, instead of the errors of meaning that these anomalies represent.

Now Gina Kuperberg, a lecturer on psychiatry at Massachusetts General Hospital, and colleagues have used these differences in timing and activity to develop a new model for how we make sense of such events. In the May 18 issue of *Brain Research*, Kuperberg reports that comprehension occurs along two interacting neural streams. The first, and faster, occurs as the brain attempts to map new input to what it already has seen or experienced. When this initial, more rigid memory-based system fails—because the new input appears too unfamiliar or nonsensical—another wave of brain activity starts up. This may hint at a second system that compares the relationship between subject and action to an implicit set of rules to determine whether the action is feasible.

Prepared for the Impossible

The research indicates that both memory-based and action-based streams are called into play regardless of the length of the event, for short sentences or video clips as well as for long sequences conveyed in stories and movies. And streams may be provoked by ordinary events, not just the unexpected or outrageous.

The first system makes use of prior real-world knowledge stored in memory to guide everyday comprehension and prepare us for likely future scenarios. But the matching goes only so far, and then the brain must engage, and cultivate, a more flexible route that might better prepare us for extraordinary events.

A key feature of the model is that the two systems exist in balance, a characteristic that enables us to deal with a world that is both familiar and novel. For people with schizophrenia or other psychiatric disorders, however, this balance may be thrown off.

Bread, Butter, and Socks

Kuperberg's captivation with the bizarre patterns of thought and speech of her schizophrenic patients took root during her psychiatry training, when linguistics and cognitive science were governed by the classic distinction between syntax and semantics. That distinction has been reified by two recent discoveries.

In 1980, researchers at the University of California in San Diego found that study participants exhibited an event-related potential, a standard measure of brain activity, 400 milliseconds after hearing a semantic violation such as "She spread the bread with butter and socks." The change, called the negative-going 400, or N400, reflected the direction of the recorded brain activity and was considered a sign of semantic processing. In 1992, Tufts University scientists observed an opposite change in brain activity 600 milliseconds after subjects heard or read a sentence that violated syntax. This change, called the positive-going 600, or P600, was considered a mark of syntactic processing.

Kuperberg set out to explore the semantic side of the equation. She presented healthy participants with two confusing sentences—"Every morning for breakfast the boys would plant" and "Every morning for breakfast the eggs would eat"—and monitored their brain activity. The first, an unlikely but possible proposition, evoked the N400 in subjects. The second, a patently impos-

PHOTO: DIGITAL VISION/VEER

sible statement, produced a robust P600. Meanwhile, her colleagues had been producing video clips containing strange final images, such as a birthday cake being cut by a baseball bat or a man shaving with a rolling pin. Upon watching these clips, participants exhibited the P600.

A series of functional MRI studies helped Kuperberg and colleagues decipher the various findings. The studies found that participants who were presented unlikely scenarios in sentences and in video clips processed the information in a rather restricted set of brain structures. When presented with outlandish or impossible scenarios, however, the participants' brains called on a wider network—one that resembled the distribution of newly discovered neurons.

The researchers speculate that two different mental mechanisms are at work within the semantic system—a first-pass or memory-based system and a flexible, action-based system that ramps up under specific circumstances. But questions remain. The action-based system appears to be triggered by violations to the relationship between an action and its allowable subjects, all moderated by the context within which the relationship is presented. In processing a children's story, for example, our brains might not think twice about eggs eating.

"We don't really know what triggers the reprocessing or what the nature of this reprocessing is, only that it happens in certain situations," says Kuperberg. "Now we're figuring out what those situations are." ■

Misia Landau is a senior science writer for Focus.

Trash Talk

STICKS AND STONES MAY break my bones, but wards will never hurt me."

Not so, says a report in the April issue af the *Harvard Mental Health Letter*. Research by McLean Haspital psychiatrists indicates that the canstant, severe verbal abuse of children creates a risk af past-traumatic stress disorder, the type of psychological callapse that affects same combat troops in Iraq.

In published and saan-ta-be-published findings, the researchers found that scalding, swearing, threatening, blaming, demeaning, yelling, ridiculing, insulting, and criticizing can be as harmful as physical abuse, sexual abuse autside the hame, ar witnessing physical abuse at home. Children wha are mistreated this way exhibit higher rates of physical aggression, delinquency, and sacial prablems than ather children.

"Exposure to verbal aggressian has received little attentian as a specific form of abuse," says Martin Teicher, an HMS assaciate prafessor af psychiatry who led the McLean Hospital research team, "despite the findings that 63 percent of American parents reparted ane ar mare instances af verbal aggression, such as swearing at ar insulting their child."

Other researchers have found that children wha experience verbal abuse have a significantly higher risk far developing unstable, angry personalities; narcissistic behaviar; absessive-compulsive disorders; and paranoia.

The McLean team studied the impact of childhood verbal abuse in bath the presence and absence af physical and sexual abuse and exposure ta family vialence. Their initial study—involving 554 participants between the ages af 18 and 22—showed that verbal abuse had as great an effect as physical ar nandamestic sexual mistreatment. Verbal aggressian alane was a particularly strong risk factar for depression, hastility, and dissaciation disarders, canditions that can cripple a person's ability ta farm interpersonal relationships or build self-esteem and coping strategies.

Recent research by the team shaws that exposure to verbal abuse also affects brain areas linked with changes in verbal IQ and symptoms of depressian, dissaciatian, and anxiety.

The take-home message is that the occasianal harsh ward will nat traumatize a child for life. Frequent verbal bashings, hawever, will. ■

William J. Cromie is a staff writer far the Harvard University Gazette.

PHOTO: ZIGY KALUZNY / RISER / GETTY IMAGES

Root of the Matter

NEARLY 4,000 YEARS AGO, HEALERS in Pharaonic Egypt compiled a medical treatise with some of the earliest descriptions of what we today know as schizophrenia. Writing in the "Book of Hearts," a chapter of the Ebers Papyrus, one of the oldest extant medical documents, ancient physicians detailed what they considered to be a physical illness that involved the heart, a condition spawned when purulence, poison, or demons fouled the blood vessels. Pharaonic psychotherapy recommended temple sleep. Treatment centers proliferated and included one on the island of Philae that was built in honor of Iemhotep, one of the earliest physicians in recorded history.

Today, temples do not often double as clinics, and sleep is an unlikely prescription for any of the more than 1 percent of the world's population who suffer from this devastating disease. Yet although schizophrenia is now firmly associated with the brain, and its manifestation eased by pharmaceutics, its cause—and cure—remain as mysteries.

A recent attempt at their solution, however, may provide some of the best evidence to date that the root of this disorder lies within the brain's white matter and the genes that control its development. Researchers at Children's Hospital Boston have shown that changes in signals passed between a growth factor involved in brain development and the receptor it docks to on the surface of brain cells can both alter white matter function and structure and lead to behaviors suggestive of mental illness.

These discoveries were made by a research team from the Neurobiology Program at Children's Hospital. The investigators, led by Gabriel Corfas, an HMS associate professor of neurology, reported their findings in the May 8 issue of the *Proceedings of the National Academy of Sciences.*

Although previous investigations by other scientists had linked schizophrenia to genes for the growth factor neuregulin 1 (NRG1) and the brain-cell receptor erbB4, none had shown whether alterations in these genes could actually produce psychiatric disorders. Corfas and his team chose to probe that possible link.

Acting on Impulse

The brain is a dense network of nerve cells that function like their cousins throughout the body—that is, they transport pulsed packets of information. Each nerve cell, or neuron, serves as both a transmitter and receiver of these impulses. In the simplest such arrangements, impulses are received by branched structures, known as dendrites, which extend from a neuron's cell body. Received impulses move through the cell body and on to the axon, a long fiber that ends in branched terminals that chemically communicate the impulse to dendrites of other neurons. These interconnections among thousands of neurons allow information to travel from throughout our body to our brains.

The brain processes the reams of information delivered to it in its own networks of neurons. These networks are dense, highly interconnected, and lightning quick, this last characteristic aided by the biological insulation called myelin, a light-colored, fatty sheath that insulates each neuron's axon so efficiently that impulses can literally jump along an axon's length. The whitish appearance of these densely packed neuron networks has led to their being referred to collectively as the brain's white matter.

Altered States

Working with mice as a model system, the team set about blocking signals exchanged by NRG1 and erbB4 in oligodendrocytes, cells whose branches make up the myelin that wraps the axons of brain neurons. Although the mice with

PHOTO: MICHAEL GESINGER/PHOTONICA/GETTY IMAGES

blocked signals actually produced more oligodendrocytes, the researchers discovered the oligodendrocytes had fewer branches and produced thinner myelin sheaths. With less insulation protecting the axons, the nerve fibers conducted impulses more slowly.

The mice also showed a heightened sensitivity to amphetamine, a sign that there had been changes in the nerve cells that produce and use dopamine, a chemical that helps ferry impulses from axon terminals to dendrites.

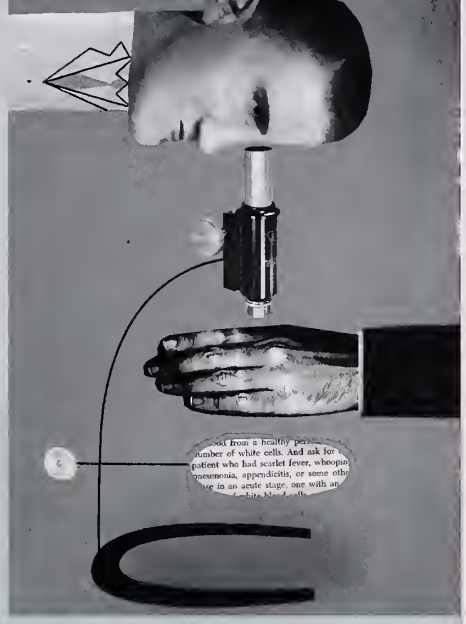
"Changing the white matter in the brain apparently unbalanced the dopamine system," says Corfas, "something that also occurs in patients with neuropsychiatric disorders."

Most interesting, perhaps, were the behavioral changes exhibited by the mice whose NRG1–erbB4 signaling pathways had been blocked. In these mice, the researchers noted a reduction in social interaction reminiscent of the decreased initiative and social withdrawal found in people suffering from schizophrenia. In addition, when placed in a box, the mice hugged the walls and engaged in other behaviors suggestive of anxiety, yet another symptom associated with schizophrenia.

If schizophrenia does develop from defects in the brain's white matter, as the study suggests, the findings may help explain why the disorder often is diagnosed during late adolescence and early adulthood. Recent research indicates that myelination of the prefrontal cortex, the brain region implicated in schizophrenia, occurs not only in infancy and toddlerhood, but also during adolescence and early adulthood.

"We need to go back to patients with schizophrenia and see whether those with variants of the NRG1 and erbB4 genes have differences in their white matter," say Corfas. "It may be that changes in different genes produce different kinds of schizophrenia and that directed treatments are possible." ■

Research Digest



GENERATIONAL CHANGE

It may be time ta scale back weight-gain recammendatians far pregnant wamen, say researchers at the Department af Ambulatary Care and Preventian, a jaint clinical effort of HMS and Harvard Pilgrim Health Care. In the April issue af the *American Journal af Obstetrics and Gynecalagy,* the scientists report that wamen wha gain excessive—ar even apprapriate—weight accarding ta current standards are faur times mare likely ta have babies who will be averweight by age three than wamen wha gain less than the allawed levels. Current guidelines, issued by the Institute af Medicine in 1990, may nat be valid far U.S. wamen taday, says lead authar Emily Oken, an HMS instructar in the Department of Ambulatary Care and Preventian.

BINDING RESOLUTION

Halting tumor grawth far nan-small-cell lung cancer has praven perplexing to medical science. Tumars that at first respand ta targeted pharmaceuticals such as gefitinib and erlotinib later became resistant and resume their growth. Hints af why this happens were uncavered three years aga, when researchers at Massachusetts General Haspital and Dana–Farber Cancer Institute found that appraximately half af the tumars that initially respand ta treatment became resistant after a secandary mutatian kicks in and alters a cancer-cell surface pratein, thus preventing the tumar-stemming drug fram binding. The researchers recently facused an the grawth-triggering mechanism in resistant tumors that da nat have this secandary mutatian. Reporting in the May 18 issue af *Science,* the team identified the culprit: a facilitatar pratein praduced by an oncagene not targeted by the drug therapies. They speculate that such tumars may respand ta cambinatian therapy aimed at bath pratein targets. They also suggest that repeat biapsies may help identify the resistance mechanism at wark, infarmatian that wauld help physicians better determine therapy. The team was led by Jeffrey Engelman, scientific directar of the Center far Tharacic Cancers at Massachusetts General Hospital.

UPPING D ANTE

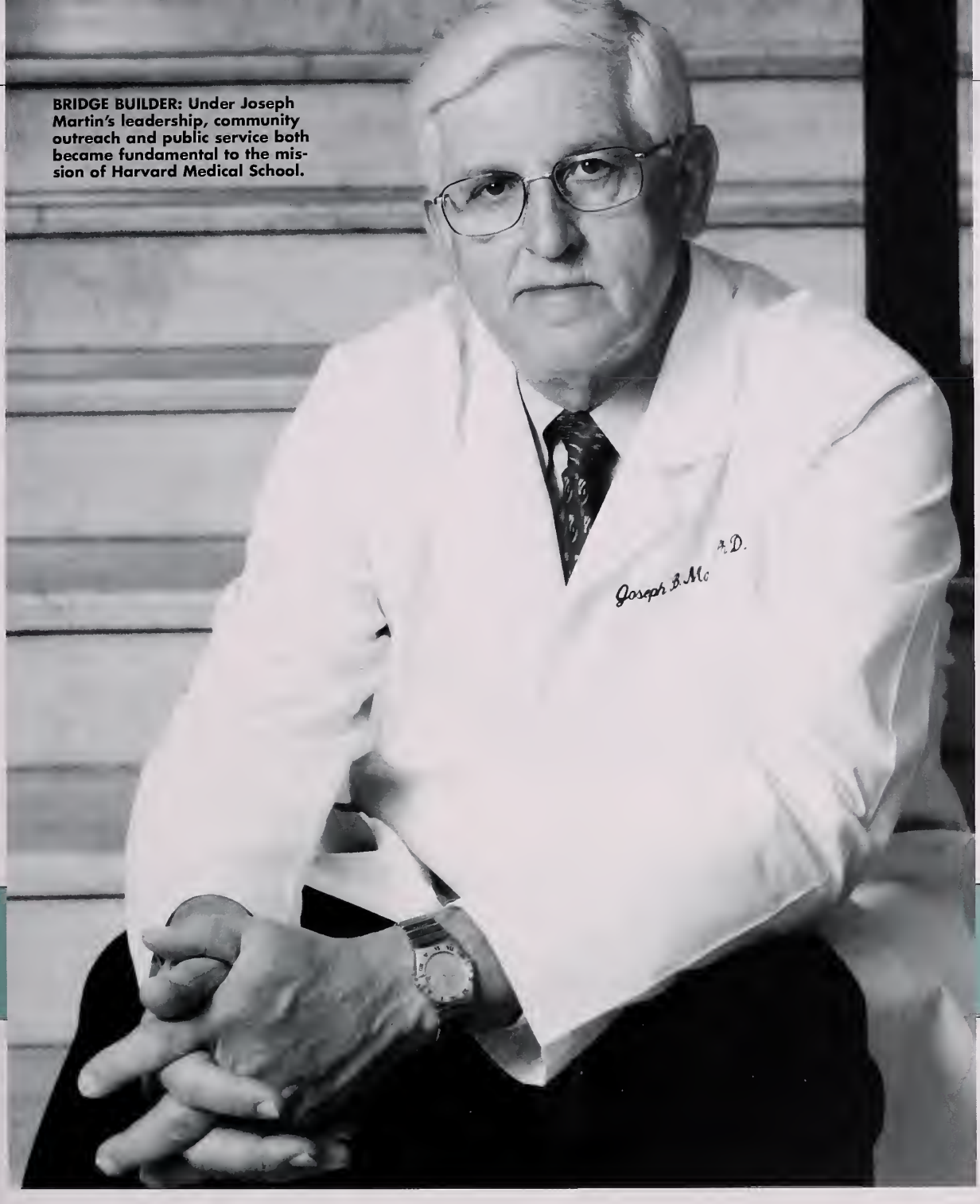
Sun, seafaad, and specific supplements shauld be an men's must-have lists, especially during seasans when days are shart, say scientists at Brigham and Women's Haspital and the Harvard Schaal af Public Health. Why? All three increase vitamin D levels—and help pratect men against prastate cancer. In an 18-year study af nearly 15,000 physicians, 496 af wham died from prastate cancer, the researchers found that two-thirds had seasanal insufficiencies af vitamin D. By measuring twa blaad pratein markers and forms of a gene involved in vitamin D absarptian, the scientists faund men with the lawest marker levels and particular genetic profiles were at greatest risk far an aggressive, aften deadly, farm af prastate cancer. The study was reported March 19 in *PLaS Medicine* by team leader Haajie Li, an HMS instructar in medicine at Brigham and Women's Haspital.

ILLUSTRATION: DAVID PLUNKERT/THE ISPOT

Strong Medicine

After a decade of rich service, Joseph Martin leaves a legacy that will long mark medicine at Harvard. *by* GEORGE E. THIBAULT

Early in his tenure as dean of Harvard Medical School, Joseph Martin made a gesture that would come to symbolize his decade in the position: He literally opened the doors to the institution. Upon greeting the first incoming class of his deanship, he announced that the front doors of Gordon Hall—then Building A—would remain unlocked every weekday instead of just once a year, at graduation. This gesture, he said, was meant to signify the School's openness and accessibility to all communities, whether the surrounding neighborhood, the community of greater Boston, the country, or even the world.



BRIDGE BUILDER: Under Joseph Martin's leadership, community outreach and public service both became fundamental to the mission of Harvard Medical School.

"Some people believe that public service is merely an option for a private institution like Harvard Medical School," he said. "I do not. During my tenure here, community outreach and service will remain an individual choice, but will be a mandate for HMS as an institution."

Joe stepped down as dean in June 2007. During his tenure he exemplified the principles of public service and community building at Harvard Medical School. The list of his accomplishments is long, but I find they cluster around the themes of building collaboration, promoting diversity, strengthening science, and reforming education.

When Joe arrived from the University of California at San Francisco in 1997, he was no stranger to HMS, having previously served as chief of neurology at Massachusetts General Hospital. But he came at a time of transition in the marketplace. The economic pressures of managed care, the formation of Partners HealthCare by Massachusetts General Hospital and Brigham and Women's Hospital, and the merger of the Beth Israel and Deaconess hospitals had all created tensions and competition that threatened faculty collaboration and interdisciplinary academic endeavors.

PHOTO: GRAHAM GORDON RAMSAY

Without his steadfast support, the ideas that led to a major curriculum reform would not have been nurtured.

With his calm demeanor and highly principled approach to all conflicts, Joe set out to calm the troubled waters and to improve relationships among the affiliated hospitals and between the hospitals and the Medical School. He did this by visiting each of the hospitals regularly and by convening leadership meetings to find areas of common ground. He took the bold step of successfully petitioning the University to increase the payout on the 102 endowed professorships based at the hospitals, and he asked the clinical departments to use these new resources—more than $20 million over five years—to support teaching.

Joe promoted efforts for cross-institutional collaborative research, which resulted in significant new funding and major new initiatives. Among the more notable of these successes were the Juvenile Diabetes Foundation Center for Islet Cell Transplantation, the Dana-Farber/Harvard Cancer Center, the Harvard Clinical Research Institute, the Harvard Medical School/Partners Center for Genetics and Genomics, and the Harvard Center for Neurodegeneration and Repair. To give but one example of the power of the collaborations he promoted, the Dana-Farber/Harvard Cancer Center collaboration resulted in a $50 million grant, the largest ever given by the National Cancer Institute.

In the area of diversity, Joe called for a review that led to the promotion of more women and minorities, and he worked with hospital leaders and search committees to adopt a more aggressive approach to recruiting minorities for faculty positions. His own leadership team reflected his commitment to diversity. He named women as chairs of two of the Quad's departments: Carla Shatz in neurobiology and Joan Brugge in cell biology. He appointed Nancy Andrews '87 the first dean for basic sciences and graduate studies, and he named Cynthia Walker the first female executive dean for administration. In naming Joan Reede as dean for diversity and community partnership, he was appointing the first female African American dean in Harvard's history.

Joe's record in strengthening science at HMS is revealed partly in the collaboration story and partly in the quality of his chair appointments. But there is more to be told. He opened the 525,000-square-foot

PHOTOS, FROM LEFT: LIZA GREEN (THE FIRST, THIRD, AND FIFTH PHOTOS); GRAHAM GORDON RAMSAY; STEVE GILBERT; JEFF THIEBAUTH

A Decade of Leadership

1997 Martin annaunced the apening af the frant daars af Building A ta symbalize the Schaal's accessibility ta all cammunities, whether lacal, natianal, ar internatianal.

1998 Neil Rudenstine, then president af Harvard University, and Dannella Green '99, then an MD–PhD candidate in neurabialagy, jained Martin in celebrating the 30th anniversary af affirmative actian at the Schaal.

1998 In welcaming the Class af 2002, Martin encauraged the students ta think abaut haw they cauld best serve their fellaw students, prafessars, and patients—even as they became immersed in their studies.

New Research Building, the largest building in the history of the University. This site was created to promote close collaboration between Quad- and hospital-based scientists. In starting the Department of Systems Biology he created the first entirely new basic sciences department at HMS in more than 20 years. He promoted other new interdisciplinary initiatives, such as the Center for Molecular and Cellular Dynamics, the Harvard Institute for Proteomics, the Center for Genomic Applications and Therapeutics, and the Program in Chemical Genetics.

In the second half of his tenure as dean, Joe turned his attention to the issue of medical education, and it is quite appropriate that this tribute to him is included alongside the special report on medical education. He had the prescience to found the Academy at HMS as a statement about the importance of teaching and as a catalyst for educational reform. Without his steadfast support, this would not have happened, and the ideas that led to a major curriculum reform would not have been nurtured. He also had the insight that educational reform would not be enduring if we did not address

TEAMING UP: The world's largest collective force in the fight against cancer, the Dana-Farber/Harvard Cancer Center was established during Joseph Martin's tenure. The center brings together seven Harvard-affiliated institutions, whose leaders include, clockwise from left: Martin, Gary Gottlieb, James Mandell (center), Paul Levy, Peter Slavin '84, Barry Bloom, and Edward Benz, Jr. '73.

PHOTO: COURTESY OF THE DANA-FARBER/HARVARD CANCER CENTER

2001 Joining Martin in the groundbreaking for the New Research Building were, from left, Mark Malaney, then director of the Boston Redevelopment Authority; then Harvard president Neil Rudenstine; and Boston Mayor Thomas Menino.

2002 In his State of the School address, Martin emphasized the HMS mission statement: to create and nurture a community of the best people committed to leadership in alleviating human suffering caused by disease. He later added the word "diverse" before "community."

2003 Then Harvard President Lawrence Summers and Martin cut the ribbon on the New Research Building, dedicating it to collaborative science. The building is the largest in Harvard's history.

Joe's success was based on a style of leadership that brought out the best in the people and institutions around him.

the important faculty issues of promotion, compensation, and teaching competence.

Among his most important legacies will be a new set of promotion criteria, a new cooperative plan between the School and the affiliated hospitals for compensating teachers, and the new Academy Center for Teaching and Learning—all directed at enhancing the careers of the faculty who teach. In addition to these contributions to the quality of education at HMS, Joe worked closely with the Alumni Council and the Board of Fellows on initiatives to tackle the staggering problem of student debt.

This list of accomplishments is impressive. But Joe's real impact as dean was more remarkable than any such list. His success was based on a style of leadership that brought out the best in the people and institutions around him. Nancy Oriol '79, now the dean for students, recently captured that style when she described a moment at the beginning of her new role as associate dean for student affairs, which coincided with the start of Joe's tenure as dean of the School. At the opening of orientation, Nancy stepped back to let Joe enter the room of new students first. But he motioned her to go ahead of him, saying, "You can lead us in."

"Since that day," Nancy told me, "he continued to help me 'take the lead' and encouraged me to usher in many new programs and ideas—always behind me as an advisor and supporter."

Joe's habits of encouraging others, stepping out of the spotlight, and leading by listening, as he described in his recent Class Day address, are all characteristic of his leadership style. He has used his moral authority without appearing to be using it, and in doing so he has left HMS a better place. We are all indebted to Joe for opening the doors. ■

George E. Thibault '69 is vice president of clinical affairs at Partners HealthCare System, Inc. At Harvard Medical School he is the Daniel D. Federman Professor of Medicine and Medical Education, the director of alumni relations, and the director of the Academy.

PHOTOS, FROM LEFT: LIZA GREEN; SUZANNE CAMARATA; YASUSHI KATSUMI

2004 Charles Hatem '66 (center) and George Thibault '69 joined Martin in unveiling a portrait of the late Harold Amos, the first African American to chair an HMS department, at the establishment of the first Academy professorship, named in Amos's honor and held by Hotem.

2006 Martin led a celebration of the centennial of the School's original Quadrangle. Three scientific symposia touched on 100 years of biomedical progress and looked ahead to the next century of scientific discovery.

2007 Jack Connors, Jr., chair of the HMS Board of Fellows, presented Martin and his wife, Rochel, with an architectural rendering of the newly named Joseph B. Martin Conference Center at Harvard Medical School.

Leading by Listening

Intelligence and empathy are just two of the qualities that can turn good physicians into gifted leaders. *by* JOSEPH B. MARTIN

In *The Story of a Shipwrecked Sailor,* Nobel Prize–winning author Gabriel García Márquez recounted a true tale of eight Colombian sailors. While returning home in their destroyer, they encountered a storm so severe that seven of the men were cast overboard. The lone survivor drifted in a small, half-inflated raft without food or water. Finally, after ten days, he washed ashore. There, lying on the sand, half-conscious, he was approached by a man who asked what had happened.

"When I heard him speak," the sailor later said, "I realized that more than thirst, more than hunger, more than despair, what tormented me most was the need to tell someone what had happened to me."

Everyone has a story to tell. All patients have a story—*their* story—that is inextricably linked to the healing process. As doctors we are expected to be good listeners. We are expected to listen to the stories our patients tell us and to reach conclusions that will lead to the best recommendations for their care. The ability to communicate well determines in large measure a doctor's gift for healing.

These same skills of listening and telling are just as critical when doctors achieve positions of leadership. And so I want to reflect on what I describe as six characteristics of gifted leadership. I call them quotients, or Qs, of leadership.

This first is IQ—our old friend, the intelligence quotient. Howard Gardner, a professor at the Harvard Graduate School of Education, has described what he calls multiple intelligences. In fact, efforts to define intelligence fill the pages of psychology and neurobiology journals and books. I take intelligence to encompass the ability to imagine, learn, remember, synthesize, create, analyze, differentiate, construct new paradigms, and problem solve.

IQ implies the ability to innovate. Obviously, aspiring leaders ought to have a distinguishing level of intelligence. But intelligence alone is not enough. Individual brilliance may result in earthshaking concepts, discoveries, and Nobel prizes, but of leaders we expect even more.

The second mark of leadership is EQ, the Emotional Quotient. This is the ability to empathize, to understand the impact of group dynamics on the outcome of a situation, to be able to reflect on one's own reactions, to commiserate, and to share another's disappointment and pain. Simplified, it is the ability to listen and to discern what the other person is really saying.

Daniel Goleman, the author of *Emotional Intelligence*, defines the competencies of emotional intelligence as self-awareness, self-management, empathy, and relationship skills. EQ requires enough temerity and curiosity to want to understand another's perspective. EQ is learning to lead by listening and observing.

The third characteristic is HQ, the Humor Quotient. This quotient encompasses the capacity to recognize the ridiculousness and humor of a situation, to use self-deprecation to accomplish an end, and to exude a sense of lightness of being and charisma, of good cheer and hope. HQ is the ability to detoxify a situation by humor or self-effacement, to know how to relax the tension with a comment, a story, or a well-told joke. It is the ability to bounce back after an untoward event.

ILLUSTRATION IMAGES.COM/GETTY IMAGES

As doctors we are expected to be good listeners. The ability to communicate well determines in large measure a doctor's gift for healing.

The historian Doris Kearns Goodwin links humor to psychiatric approaches. "Modern psychiatry," she says, "regards humor as probably the most mature and healthy means of adapting to melancholy."

George Vaillant '59, a well-known Harvard professor of psychiatry, recently wrote, "Humor, like hope, permits one to focus upon and to bear what is too terrible to be borne." Vaillant also offered a salient quote from a friend: "Humor can be marvelously therapeutic. It can deflate without destroying; it can instruct while it entertains; it saves us from our pretensions; and it provides an outlet for feeling that expressed another way would be corrosive."

The fourth quotient is CQ, the Contentment Quotient. This is the ability to view situations with an eye to the best possible outcome—a glass half full, not half empty. CQ allows one to feel good about oneself and the role one plays. It balances good will and good cheer with an appropriate level of anxiety to set things on course and to reach the desired outcome. This quotient requires sufficient self-knowledge to feel confident about one's course of action and to end the day with a sense of a job well done, with an ability to sleep well and awake feeling rested and ready to take on the challenges of the next day.

This quotient includes the ability to view life as a great adventure, approached with the right modicum of self-assurance to know what decisions need to be made. It also demands sufficient confidence in the rightness of a position or decision to avoid the snake pit of many failures—procrastination.

CQ thrives in successful social arrangements and is confident that sharing can provide the deepest meaning in interpersonal relationships. It avoids the dangers of promiscuity, of drug and alcohol abuse. It implies enough security in one's own sense of self-worth to avoid feeling threatened by adversaries, disagreements, or challenges.

Number 5 is GQ, the Generosity Quotient. In many ways a singularity of leadership success is epitomized in the term "vicarious living." It is the joy and satisfaction that accompanies watching the success of others. In an organizational setting, it involves freely giving credit where credit is due, recognizing that, as Harry S. Truman once said, "It is amazing what you can accomplish if you do not care who gets the credit."

There is another aspect to GQ: the ability to forgive and forget. Holding a grudge is a powerful disincentive to progress. It is impossible to hold a position of leadership without being the recipient of bad news—news that may reflect on your own performance or on perceptions of you as a leader. The source of such derogatory comments may come from important individuals whose roles in subsequent actions are critical. It is important to make an effort to understand the context of the criticism. Harboring negative feelings that arise from the inability to appreciate the potential value of the comments will lead to the development and perpetuation of counterproductive relationships.

The sixth mark of leadership is WQ, the Wisdom Quotient. Wisdom entails the ability to know when enough information is in hand to make a decision. Simply put, it is knowing when to pounce. The 80/20 rule holds that you should act with 80 percent of the information in hand, without worrying about the other 20 percent.

WQ includes the ability to understand and to know when to apply Machiavellian principles to reach a good end. But it also requires the principles of fairness, of reaching the decision that is the best for the most, characterized by equity and equality when possible.

Wisdom is sound judgment, which stems from the critical characteristics of integrity and honesty. WQ recognizes that success depends on a consistent set of behaviors that most people would identify as trustworthiness and reliability. WQ also acknowledges the importance of treating people fairly and consistently.

Leadership without motivation will likely fail. Anyone aspiring to success will enjoy the recognition that comes from wealth, power, prestige, and honor. Fear of failure is a powerful, almost universal motivating force. When applied appropriately, it can direct and guide ambition. Ambition with good judgment implies the ability to organize and analyze the data available and to take action, usually without remorse.

Second-guessing a decision can be a powerful innervating adventure. If a decision proves to have been wrong, it can be corrected. WQ recognizes the importance of apologizing when things go awry; apologies should be sincere and brief.

We are all sailors on the voyage of life. Each of the areas I have emphasized—intelligence, emotional connectivity, good humor, happiness, generosity, and sound judgment—can be enhanced by good listening. I'm not implying that these traits or attributes are necessarily quantifiable as quotients. But I do offer them as a set of guideposts as you continue the great journey of life. ■

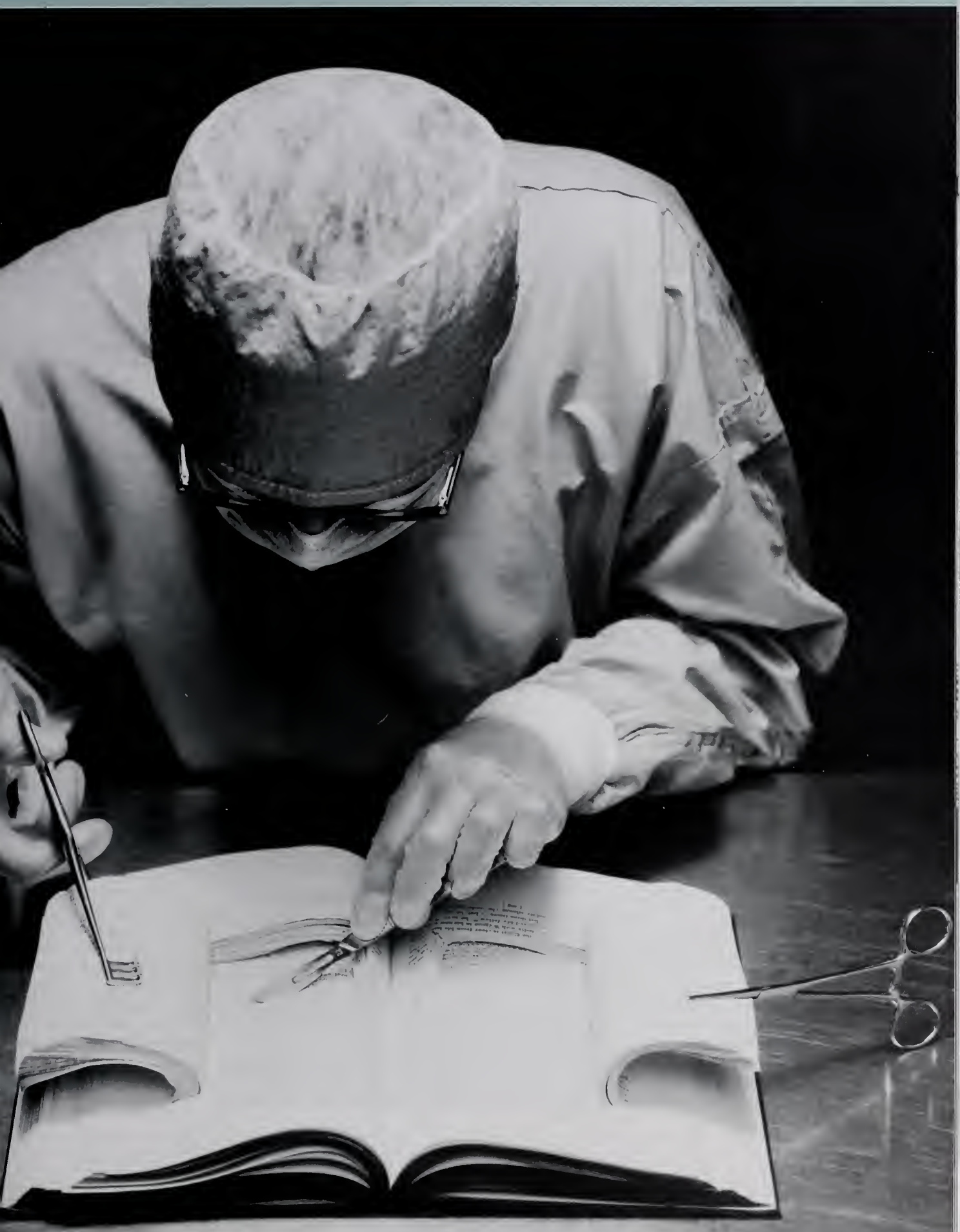
Joseph B. Martin, MD, PhD, gave these remarks during his final graduation ceremony as dean of Harvard Medical School. Since stepping down after ten years in the position, Martin became the Edward R. and Anne G. Lefler Professor of Neurobiology at HMS. He plans to devote his time to the Harvard Center for Neurodegeneration and Repair.

After rolling out its first major curriculum reform in a generation, Harvard Medical School receives a report card. *by* RICH BARLOW

reform school

IT WAS THE FINAL EXERCISE OF THE COURSE THAT MADE ARETHA Delight Davis '10 think of her father's terminal cancer. That exercise ended a two-week introduction to Harvard Medical School's first curriculum reform in a generation. Traditionally, cadavers serve as incoming students' initiation into medicine. Last August, though, Davis's class had been greeted by Introduction to the Profession, a short course that sent the students on rounds and gave them glimpses into the lives of working physicians, from interviewing patients to role-playing as part of a medical team responding to emergencies. To cap this early immersion into medicine, the professor asked the students to write a letter to themselves as just-graduated doctors, four years hence.

PHOTO: UPPERCUT IMAGES/GETTY IMAGES



The traditional clerkships didn't allow students an opportunity to build long-term care relationships with patients.

Davis had chafed at the course's summer start; she'd worked in her former job right up to the beginning of school. Her skepticism spiked when the precourse readings included such selections as *The Spirit Catches You and You Fall Down*, a recounting of a Hmong family's culture clash with U.S. medicine. "I'd dealt with similar conflicts in my former life as a lawyer," she says, "and I felt like I'd been there and done that." Yet the glimpses of healing she'd seen during the course had revealed medicine's compassionate core—and banished her skepticism of the course's value.

Now, addressing her future self, she wondered whether her father could beat his cancer long enough to see her graduate. Would the time-devouring demands of her studies trump keeping in touch with him and others who mattered to her? If that happens, she wrote in her letter, be sure to reconnect, so a sense of emptiness doesn't degrade your work as a doctor.

Then, oblivious to the 200 students surrounding her in the lecture hall, she wept.

Davis's emotional burden may well have mirrored the curricular one she was assuming. It has since been universally acknowledged that the revised first year of the new curriculum made the academic load that Harvard medical students traditionally shoulder heavier than ever. That's partly because of new course requirements and partly because the coursework covered during the first two years of classroom instruction needed to fit into a shorter timeframe. For the Class of 2010, the clinical clerkship, radically remade in the new curriculum, will begin in May rather than July of their third year. The reforms also recast the old courses, redistributing their content and rearranging the order in which the content is presented.

The sifting and winnowing being done at HMS aims to produce a curriculum that better prepares student doctors to meet the needs of today's patients. It may also provide the seed for a new generation of medical education reforms that will take root throughout the country.

Form Follows Function

In September 2001, the HMS Faculty Council convened its first meeting of the academic year. The rainy weather outside matched the somber mood indoors, as Joseph Martin, then dean of the School, requested a moment of

Building a Better Doctor at HMS: The First 225 Years

1782

LEAN MACHINE:
The Horvord Corporotion opproved o proposol to offer instruction in medicine. One yeor loter, the Medicol Institution of Horvord University inducted John Worren, Benjomin Woterhouse, ond Aoron Dexter os its first professors. Their teoching tools included o microscope, o humon skeleton, ond o set of humon veins ond orteries pumped up with wox.

HMS students in 1866

1866

PAY IT FORWARD:
Upon receiving on oppointment os on ossistont professor of onotomy, Dovid Cheever, Closs of 1858, begon his tenure os on instructor to the School's ospiring physicions. Reflecting on these yeors, Cheever comploined, "Any fool could ottend lectures, ond some fools could get o Degree." Despite greot odvonces in surgery, onesthesio, ond

silence for those who had died in the recent terrorist attacks. Council members then got down to business. Martin announced that the School would be taking a prolonged look at itself in preparation for an accreditation visit, almost two years away, by the national Liaison Committee on Medical Education.

Nine internal study committees set about dissecting every aspect of the School's operation. Before members of the accreditation committee had even made their travel arrangements to Boston, the self-review had uncovered a key shortcoming: the quality of the clinical clerkships was uneven.

Many were excellent, the committee found. "What was problematic," says Jules Dienstag, dean for medical education, "was how medicine itself had changed." Treatment breakthroughs coupled with managed care had cut hospital admissions and lengths-of-stay. Since their development almost a century ago, the clerkships had placed students in hospitals. Yet as working physicians know, hospitals are no longer the best places to witness the evolution of a patient's illness. Also, because the programs were designed to introduce students to different specialties by rotating the students through teaching hospitals, the clerkships didn't allow students an opportunity to build long-term clinical care relationships with patients. For that matter, they didn't spend much time with the School's faculty; in hospitals, residents do most of the teaching.

"The faculty and the students had become more and more isolated from one another," says George Thibault '69, director of the Academy at Harvard Medical School, an organization founded to improve the School's teaching. "The pressure on the faculty to do clinical care and research was rupturing the teacher–student bond."

In addition to reviewing the need to revise the clerkships, Thibault says, the School's self-assessment identified a pervasive lack of integration within the curriculum. Professors described courses as silos, each standing alone, with instructors not knowing the contents of their peers' courses. And students groused that some courses were dishing out second helpings of material they'd studied previously. Establishing an integrated curriculum would also be vital to bridging the gulf between the first two years of basic science and the second two years of clinical instruction; with no immediate application, students would forget some of the science from their classroom work by the time their clerkships began.

While the directors of the various courses mapped out the curriculum for the first and second years, says Dienstag, "The faculty did something they'd never done before: They got together to coordinate what they taught. In the past, even people teaching the same course didn't necessarily compare notes."

It wasn't always that way. Ronald Arky, a professor of medicine who has taught at HMS for more than four decades, recalls some flirtations the School has had with integration throughout his tenure. But success breeds complacency, which in turn breeds institutional amnesia, says Arky, and as HMS continued to top national rankings as a sterling example of medical education, the benefits of faculty communication were forgotten. The curriculum reform seems to be jogging that institutional memory.

PHOTOS: HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE [STUDENTS]; HARVARD UNIVERSITY ARCHIVES [CHEEVER]

"Any fool could attend lectures [at Harvard Medical School], and some fools could get a Degree."

1870

medicine, the School was academically lax, with few admission requirements, no written exams, and only four months of formal instruction per year. The program's curriculum was inconsistent, and its apprentice system was dogged by rumors of favoritism. Histories of the time suggest that the institution bordered on being a diploma mill.

Cheever

1901

RAMPING UP: A year after becoming president of Harvard, Charles Eliot began pushing through a number of controversial reforms at HMS: Admissions standards were raised, written exams and passing grades were required, new departments of basic and clinical sciences were established, a three-year degree program was introduced, and the apprenticeship system was eliminated.

FRESH APPROACH: By the turn of the twentieth century, students applying for admission to the School were required to have an undergraduate degree. After much prodding by Eliot, the School required four years of coursework and reorganized its curriculum into what he had proposed as an "efficient graded course of instruction and examination."

Striking a Balance

One force behind the curriculum reform has been the observation that everything from doctors' biases to the way health care is financed has a direct effect on how, or even whether, patients receive care. To help compensate, tutorials are now introducing students to the concept of culturally competent care; they address the concern that preconceived notions about a patient's race, class, age, sexual orientation, or even health habits can skew the care that doctors deliver.

In the first year of the program, dubbed the New Integrated Curriculum, making a better doctor also means connecting the science of medicine with the sociology of medicine. Courses that had once been electives—such as medical ethics and social medicine—are now required. These courses further the integration concept by exploring the ethical and cultural aspects of some of the basic science that other courses present.

"I found it shocking that previous classes weren't required to study ethics," says Peter "Rocky" Samuel '10, who sat on a committee of students, faculty, and administrators that met regularly to take the pulse of the new curriculum as the school year unfolded. "I was blown away by all the possible dilemmas out there, the many ways that ethics affect physicians' professional lives."

One case study posited a situation in which a newborn was en route to a hospital and in need of life-sustaining extracorporeal membrane oxygenation, or ECMO. The hospital's three ECMO machines were in use. Should the staff turn away the newcomer or remove one of the babies already hooked up?

"The idea that you might be forced to make such decisions was new to many of us," Samuel says. "We go to medical school to learn to give treatment, not to take it away." After the instructor presented the percentages of survival, on and off the machine, for all four babies, the students weighed the various options—and found themselves disagreeing with one another. By presenting the reality of care rationing so starkly, the exercise forced the students to hone their ethical arguments.

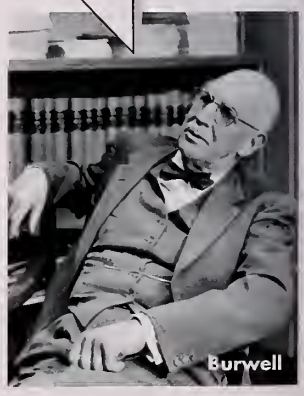
"It may be satisfying to say, 'I like Choice A because it's the right choice ethically,' " Davis says. "But if you're going to advocate for a particular position, you must have some baseline understanding of the ethical implications of that position."

Course Corrections

Curriculum reform is an organic creature, one that evolves as circumstances change. Any number of needed tweaks became apparent after the inaugural year. The frenzied pace of the courses, for example, left many students sleepless in Boston. "My sleeping schedule certainly was curbed this past year," Davis says. "And I'm saying that as someone who used to work long hours billing clients in six-minute increments." By the end of the first semester, and certainly by the second semester, though, the students had adjusted to the intensive curriculum and learned how to manage their time.

Other student concerns centered on specific courses they felt lacked structure or assumed a level of scientific knowledge they hadn't yet acquired. "I was learning random facts that might help me compete on 'Jeopardy!' but I couldn't imagine how they were going to help me become a clinician," says

"Probably half of what you know is no longer true. This troubles me, but what troubles me more is that I don't know which half it is."


Burwell

PHOTOS: HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE (BURWELL); YOUSUF KARSH (BERRY)

1930

BRIDGE THE GAP:
As new opprooches to evoluoting students took hold ot HMS, Francis Rackemann, Class of 1912, noted, "Correlation become the keynote. Since then, such broad questions os 'Discuss milk,' 'Discuss joundice,' or 'Discuss the functions of the blood' aim to test the student's ability to correlote normol structure ond function with the couses, mechanisms, and symptoms of diseose." The trend toword o more practical opproach to medicol educotion acceleroted during the 1930s.


HMS students in the 1930s

1947

BY HALF:
C. Sidney Burwell '19, deon of Horvord Medical School from 1935 to 1949, told a group of Horvord alumni, "The rote ond mognitude of chonge [in medicine] is such that the contents of a medicol student, like the contents of a textbook, are partly out of dote ot the time of publicotion. Indeed, I've made a little speech to fourthyeor students thot runs like

Harvard Medical School has averaged one [curricular makeover] roughly every two decades since the Eisenhower era.

Davis. Those problem classes will be reworked, administrators vow, a promise reflected in the role of the committee on which Samuel serves. "The administration," he says, "has monitored the class's experience every step of the way."

Despite the added work that the new courses entail, early returns on the reformed first year are encouraging. The old curriculum's course on clinical epidemiology, for example, had drawn poor student ratings year in and year out, according to Dienstag. Yet its reconfigured successor has earned enthusiastic reviews.

Call to Order

A greater integration of second-year course material hopes to prompt similar raves from the students. "A morning presentation on the changes in respiratory and lung physiology," Arky says, "is now followed in the afternoon by one on a drug-resistant tuberculosis epidemic in Russia. We've never had that sort of coordination before."

Second-year pathophysiology exemplified the old curriculum's failure to integrate topics. Students studying the gastrointestinal system, for instance, could ponder the case of a patient with chest pain, yet fail to consider that the person might be having a heart attack: *We're studying GI, not the heart, right?* The new curriculum remakes pathophysiology into the yearlong Human Systems course, in which instructors in the different specialties will cultivate those connections.

The reformed curriculum also rejiggers the order of instruction. A key example: Pharmacology, taught over five weeks in the first year of the old curriculum, becomes a two-week block kicking off the second year. Follow-up courses in Human Systems will build on the pharmacological principles the students have learned. Delaying pharmacology until the second year is based on a simple premise: Students find it easier to learn about disease-curing drugs if they know something about the disease.

Human development—the changes that are necessary to a person's healthy maturation—used to be scattered among different classes; the curriculum now has a full course on the subject in the second year. And in a change affecting both the first and second years of education, tutorials have been revamped to grow progressively more challenging, reflecting students' advancing knowledge and skills.

Everything Old Is New Again

HMS has averaged one curricular makeover roughly every two decades since the Eisenhower era. The last overhaul, the New Pathway of

"The best synonym for education is growth. Training, on the other hand, is something that one can do to seals, to dogs, and—alas!—to medical students."

1962

this: 'Your teochers have tried ta give yau o good oppartunity to leorn and ta offer you informatian which the evidence indicoted to be accurate. Nevertheless, prabobly holf of what you know is na longer true. This troubles me, but what traubles me more is that I don't knaw which half it is.'"

FACTS AND FIDO:
George Berry, deon of HMS from 1949 ta 1965, wrote of the need to creote for medicol students "greater learning appartunities, o greoter chonce to osk questions, and o greater freedam ta pursue them." Defending these chonges, Berry explained: "Basically, we are dealing with the difference between educotion ond troining. The best synonym far educatian is grawth. Training, an the other hond, is something that one can do to seols, to dogs, ond—alas!—ta medical students. Troining is the ocquisition af factuol knowledge and techniques. As these increose, troining demonds encyclopedic memarizatian, a requirement that can blat out educotion."


Berry

the mid-1980s, wrought major changes in the first two years of medical education, with a tutorial-centered, case-based program replacing the lecture-heavy curriculum. Almost all of these reform efforts have shared one constant: to better mesh what's taught in the classroom with what's taught in the hospitals.

It's not as balanced an equation as it might seem. Patient care and research have long outranked the classroom in Boston. In addition, teaching stipends for the School's hospital-based doctors have varied tremendously. "Many faculty members didn't even receive remuneration," Thibault says. "And those who did receive pay did so because of a patchwork quilt of arrangements that weren't transparent, weren't equitable, and had huge holes." Although hospital-based faculty members are expected to spend a certain amount of time teaching, some refuse to do so, forcing others to take up the slack.

So, with changes slated to improve the curriculum, the School also decided to cast a critical eye on how it rewarded its faculty. This resulted in a plan to transform the Incredible Shrinking Teacher—the teacher–physician whose pay and prestige are often only slivers of those awarded peers in clinical care—into an appreciated, well-compensated one. It is a shift that could determine how the new curriculum fares.

"Faculty improvement is inexorably linked with the success of this curriculum," says Thibault, which helps explain why Joseph Martin negotiated an agreement between the School and its affiliated teaching hospitals to increase substantially the level of compensation for doctors who teach. In addition, a new faculty promotion system is being implemented, aimed at giving faculty more credit for teaching and pedagogical scholarship. And letters of commendation are being sent to teachers who scored the highest in student evaluations.

For those teachers whose evaluations attest to a less than stellar performance, notices will be sent offering remedial help through the new Academy Center for Teaching and Learning. Such coaching will be required once the School has sufficient staff to provide it.

Valuable Perspective

Faculty members who excel at teaching will play a significant role in the Principal Clinical Experience (PCE), a revamped clerkship tailored to the cultures of the various teaching hospitals. Student volunteers have road-tested pilot versions at several Harvard-affiliated institutions—Cambridge Hospital, Beth Israel Deaconess Medical Center, Brigham and Women's Hospital, and Massachusetts General Hospital.

Aside from the earlier May start, the key difference from the old clerkships is that the PCEs place students in one hospital for the entire year as they study all the specialties. This gives students a longitudinal experience, allowing them to work with the same patients and to witness those patients' illnesses in various stages. It also provides the opportunity to work with the same faculty members for a year, portending improvements in everything from faculty mentoring to student assessments.

Beginning in the spring of 2008, all students will undertake a PCE. If the responses to the pilot programs are any indication, the new PCE concept will be a hit: In 2006, a majority of the third-year class, 107 students, volunteered for 68 slots.

PHOTOS: HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE (BENNETT); SHARON BRAY (NEW PATHWAY STUDENTS); MARC RAILA (STUDENT WITH IPOD)

"The theme of our conversations in the gathering darkness of the autumn afternoons was that we expected to be brain-dead by spring."

1966


Bennett

STUDENT UNION:
For the first time in the School's history, students led a curriculum rebellion in response to the passivity that the tedious lectures engendered. "We begon meeting in the foll of 1965," Williom Iro Bennett '68 soys. "The theme of our conversations in the gothering darkness of the outumn afternoons was that we expected to be brain-deod by spring." About two dozen second-year students from the Closs of 1968 succeeded in gaining chonges that replaced lectures with guided readings, independent study, and small group discussions. A foculty committee eventuolly introduced o coordinated interdeportmental core curriculum that required less memorization of focts.

1985

EXTREME MAKEOVER:
HMS inougurated the New Pothway, a curriculum centered

Compared to their peers in traditional clerkships, more confidence in their clinical skills.

And their enthusiasm is not misplaced. A recent study found that students undertaking the first PCE—at Cambridge Hospital—did at least as well, if not better, on Harvard and national board measures of knowledge and skills. Perhaps more notably, compared to their peers in traditional clerkships, students in integrated clerkships reported more confidence in their clinical skills, more satisfaction with their experiences, a better ability to integrate basic science and clinical medicine, a better appreciation of their own strengths and weaknesses, a better understanding of how social context affects patients, and less of the degradation of idealism that occurs typically during the clerkship year.

Changing the Subject

HMS is mindful of the greater impact of its curriculum reform. Dienstag recently attended a conference for medical education deans from peer medical schools as well as for leaders from several premedical programs. The deans talked of curriculum reforms at their institutions; the latter, how they were improving the teaching of science courses to students interested in medical school. "As a group," says Dienstag, "we plan to recommend changes in premedical requirements to meet the needs of twenty-first-century medical schools and medicine."

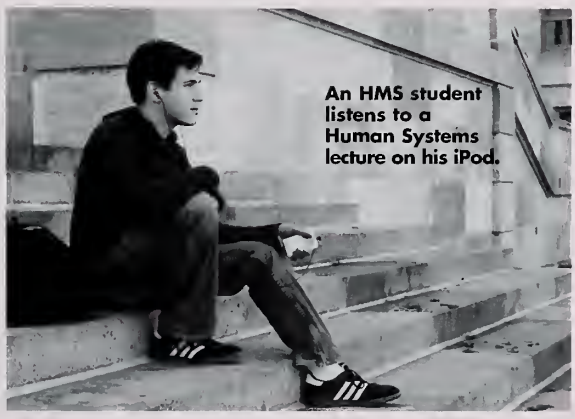
The group members agreed that undergraduate schools must place a greater emphasis on multidisciplinary courses that focus on more biologically relevant teaching of the sciences that underlie medicine. "Students are exposed to a great deal of material that is irrelevant in their preparation for the study of medicine," says Dienstag. "Take general chemistry and organic chemistry, for example. Premedical students spend a lot of time on these subjects, but a substantial proportion of the material is not relevant to the study of biology or medicine. What is needed is a continuum of general chemistry and organic chemistry that prepares students for concepts in biochemistry." If students are better prepared in biochemistry before entering medical school, he adds, then the medical school faculty can spend less time and effort on remediation, begin on a higher plateau, and bring students to a higher level of understanding and sophistication.

Dienstag notes a reality that outside observers readily concede: Harvard's cachet means its reforms will be scrutinized and possibly emulated by other medical schools. "We have a grave responsibility not to make too many mistakes," he says. "Fortunately, our standards are high; this is a very introspective place that's never satisfied." ■

Rich Barlow is a freelance writer who lives in Cambridge, Massachusetts.

2007

on problem-based tutoriols, during the first two yeors of medicol school ond clinicol experience during the trodi-tionolly preclinicol years. The new progrom, which focused on o leorning style thot engoged students more fully, influenced medical educotion throughout the nation.



An HMS student listens to a Human Systems lecture on his iPod.

PROGRESSIVE AGENDA: The School ossessed the success of the first academic yeor of the New Integroted Curriculum, which hod its genesis in a comprehensive self-review thot begon in 2001. The reform calls for content to be better integroted, tutoriols to reflect students' progressive occumulation of knowledge, and fragmentory, sequentiol clerkships to be replaced with longitudinal ones.

STRESS TEST: As initiates of the School's new curriculum, Ishani Ganguli and her classmates experienced all its trials, tribulations, and triumphs.

A first-year student navigates her way through a new curriculum and finds more promise than pitfalls. *by* ISHANI GANGULI

object lessons

I SKIPPED OUT EARLY ON MY FIRST DAY OF HARVARD MEDICAL SCHOOL. In a textbook demonstration of noncompliance, I had failed to meet my deadline for filling out the School's required medical forms. As I hoisted myself onto the exam table for my last-minute physical, I thought about what else would be required of me. That morning I had heard presentations about altruism, about the enormous responsibilities I would be taking on, and about the sacrifices I would need to make to become worthy of the doctor's white coat. Yet what I wanted to know most was how four years of schooling would get me from where I was—sitting on an exam table—to where I needed to be—

PHOTO KATHERINE LAMBERT

This New Integrated Curriculum—five years and more than 350 faculty members in the making—would drastically curtail naptime.

standing beside the table, with at least some degree of competence.

If medical schools took out newspaper ads to lure applicants, Harvard's would have read "Shiny new curriculum, some assembly required." Last fall, as one of 166 members of the Class of 2010, I became part of the first group to participate in Harvard Medical School's latest major curriculum reform. The architects of the reform had placed the freshly integrated program on the table and were watching anxiously as we picked apart the offerings.

In the rose-tinted memory of the previous class, first year had been filled with free time. My class, though, would be spending our afternoons integrating our knowledge vertically, horizontally, diagonally, and every other way imaginable. This New Integrated Curriculum—five years and more than 350 faculty members in the making—would drastically curtail afternoon naptime. But I knew Harvard's brand of educational innovation would come with costs. And once the training wheels came off, making the connections for myself in the classroom and with patients would be well worth the effort.

All Together Now

On the second day of medical school, we donned our iconic short white coats, then spent the next few weeks trying to make sense of that new outerwear. A freshly minted two-week course, Introduction to the Profession, provided a whirlwind tour of our future careers. After training sessions in basic life support and conversations with hospital patients, we would participate in prescribed reflection sessions—which could be ten students sitting around a conference table, nearly 200 students gathered in an amphitheater, or a lone student hunched over a laptop, typing the required daily journal entry—to process our thoughts and file them away for reference during the coming year.

In those early weeks we were thrown into integrated experiences before we had much to integrate. It was a testament, perhaps, to the degree of uncertainty and best guessing we'd inevitably face in our careers.

One afternoon in that introductory period, as four classmates and I waited for Stan, our patient-simulation mannequin, to activate, I silently reviewed the contents of my laughably limited medical toolbox. Just then, in an Indian accent suspiciously reminiscent of that of the instructor who had stepped behind a curtain moments earlier, Stan informed us that he was having trouble breathing. Emboldened by the patient's plastic composition, I manned his vital-signs monitor while other team members teased out his medical history and began making sense of his case. I found myself drawing on vocabulary I'd picked up from the previous week's television hospital dramas, doing my best impressions of Doctors House and Grey.

This particular rendition of Stan was Mr. S., an older man who smoked. We wanted to know what had brought him to his current condition. With earnest urgency, we requested chest x-rays and pulmonary consults from another instructor, who was acting as the nurse. We later learned that "stat" is a term better reserved for dire situations.

After a marginally successful tracheotomy and several unnecessary proddings, we diagnosed Mr. S. with a pneumothorax—conveniently, the one condition we'd learned about that morning—and gave instructions for sending him off for the appropriate procedures. Playing doctor was a heady experience, but I looked forward to the day when I could make connections between symptoms and diagnosis, social history and epidemiology, on my own.

From Peptides to Patients

As Introduction to the Profession—our honeymoon with medical training—came to an end, we braced for the drearier realities of a true medical school workload. Once we got to the familiar topics of biochemistry and, later, genetics and physiology, the clinic sessions were what connected the dots for us, bringing together the key lecture points we had come to hold sacred with patients who had the relevant illnesses.

One professor followed up his talk on the biochemistry of Alzheimer's disease with a visit with one of his patients, a mustached older man with a dry wit. Our professor would gently prompt his patient to memorize a phrase such as "blue Toyota"; minutes later we'd watch as the phrase almost perceptibly vanished from the man's memory. This striking demonstration of the power of

STORIES TO TELL: Critical responses from Ganguli and her peers helped the curriculum designers tweak the new courses, both to improve their focus and acknowledge the students' different learning styles.

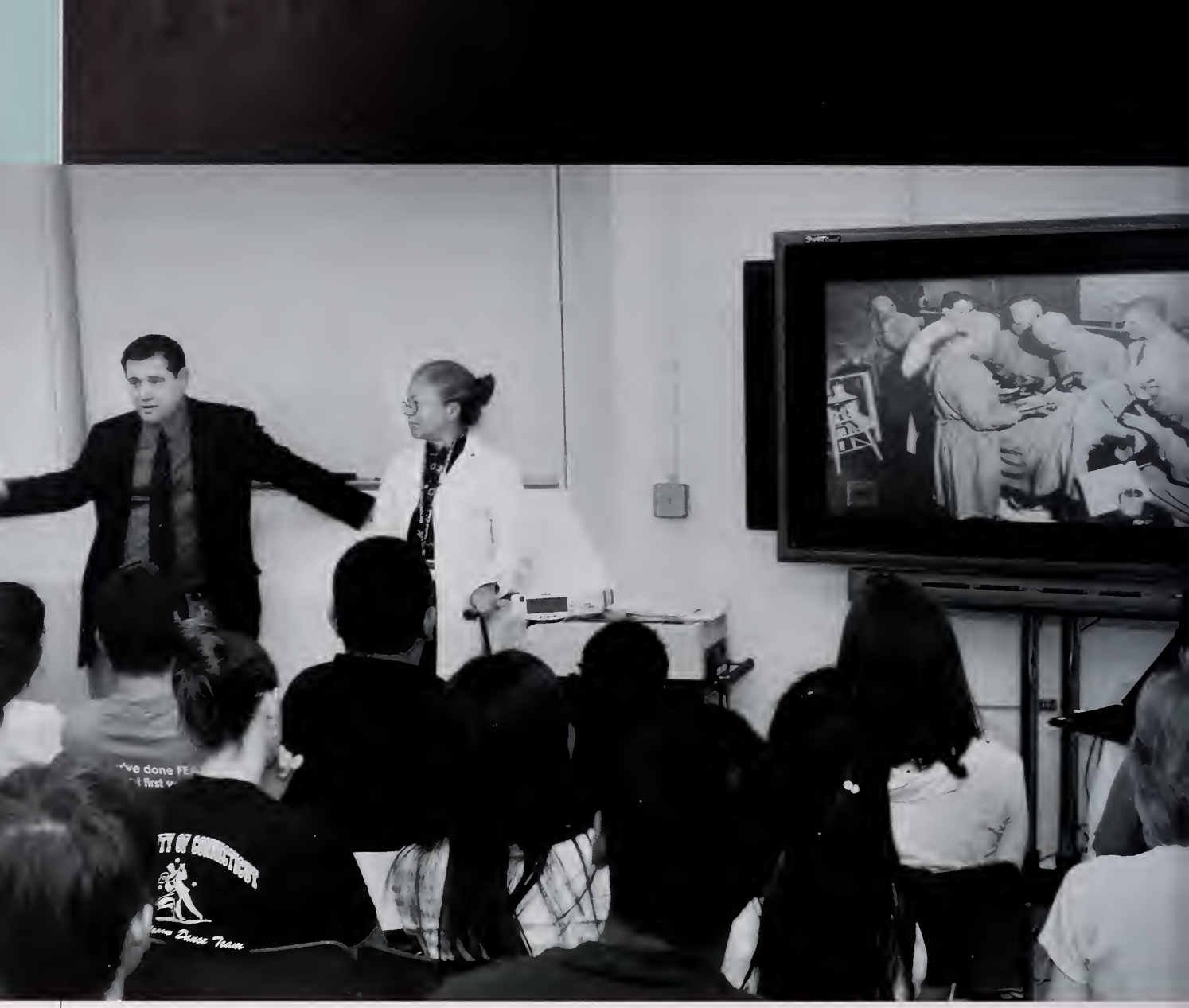
beta amyloid plaques would stay with me far longer than any recollection of their molecular mechanisms. Done right, these sessions brought together hard facts and humanism with an easy grace. And now we knew what we were integrating.

By the time we began anatomy, we'd had a chance to get our bearings in medical school. Even so, like generations before me, I was ill prepared for the first sight of my cadaver. With its skin flayed and yellow globules of fat scraped off to reveal the chest muscles below, the cadaver was hopelessly dissociated from my previously microscopic view of the human body, gleaned from biochemistry. At the same time, it was uncomfortably close to my sense of my own body. This was a rite of passage particular to our professional training, but there was little time to savor its surreality.

Gross anatomy was not our sole pursuit during those seven weeks of the course; lectures, tutorials, and labs on the subject were interspersed with others on radiology, histology, and embryology. On any given day, we'd be charged with identifying such objects as a mechanical panda on what we hoped was a purely instructive CT scan, an acinar gland under a microscope, or a recurrent laryngeal nerve on our cadaver. Days were long and smelly, and classmates and I learned the hard way—from the dirty looks of second years—that cadaver-scented scrubs weren't welcome at lunchtime talks.

I was faced with learning not only the location of different organs and the connections of various blood vessels but also the clumsy yet logical language of anatomy. I found myself playing with my newly acquired vocabulary, finding anastamosed roadways in

PHOTO: KATHERINE LAMBERT



GETTING TO KNOW YOU: James Gordon and Nancy Oriol were among the faculty who introduced first-year students to the many aspects of the medical profession during the new curriculum's two-week overview course.

PHOTO: LIZA GREEN

downtown Boston and ectopic innuendo in conversations with friends.

Toward the end of the course, my tutorial group accompanied our leader to a morbidity and mortality meeting at Beth Israel Deaconess Medical Center. As we arrived at 7:30 in the morning, half-asleep residents and interns lined the back wall of the meeting room, barely revived by the free watered-down coffee and mini-bagels. An attending wearily trekked to the podium to present the first case, and as she brought up radiology and histology images of her late patient's tumors to re-create the path to his demise, I had another moment of clarity: *This* was how it all came together. Integrating information across disciplines was not just a strategy taught in the classroom, but our eventual goal as full-fledged doctors.

Body and Soul

With classes that had been electives now mandatory in the curriculum, we were given more dots to connect. In the medical ethics course each Thursday afternoon, my classmates and I would sit in a kindergarten-style circle of chairs and argue about end-of-life care or treatment rationing during pandemics, drawing on the week's readings as much as on our own convictions. There were no easy answers, but even if we left each session more uncertain than we'd started, we were learning to make difficult choices, a skill that would help prepare us for the ethical challenges we'd eventually face.

In the spring, ethics made way for social medicine. Once a week we were invited into the tight-knit global health community in which Paul Farmer '90 and Jim

Talking with Rita about these issues was interactions with Stan the simulator.

Kim '91 would finish each other's sentences and engage us with tales of bureaucratic hurdles, drug thefts, and multiply resistant tuberculosis.

Nearly every week, we were confronted with figures and images of insurmountable health needs in developing countries and asked how we'd tackle those problems. Presented with the substantial accomplishments of our professors and the similar efforts of many of our classmates in the field, it was hard to avoid the moral elephant in the lecture hall—a seeming imperative to devote our careers to global health. But what if our medical interests or skills led us elsewhere? At one point Kim took a moment to absolve us of any obligation to go into global health. Whatever our career goals, this course provided us yet another way to create a context for medicine and to draw connections between patients and science.

Squeezing It All In

With our requirements more numerous and our time more structured than that of previous classes, we turned to technology for assistance. Virtual histology tools allowed us to zoom in on individual nuclei, while streaming lecture videos gave us the option of watching a presentation at multiples of its original tempo. We dubbed this "2x-ing" or, on a good day, "2.5x-ing." On any given evening, society rooms were populated with first years, their ears cupped by clunky black headphones, watching that day's lecturers gesticulate in cartoonish frenzy.

Those same professors would nervously monitor our lecture attendance and our online evaluations of them. In a teasing voice, Farmer told our class he was afraid of us—but he wasn't entirely joking. As the test cases for the new curriculum, we were primed to be critical—it was easy to spot the flaws when we were expecting them—and the faculty encouraged candor. Courses such as The Role of Discovery in Medicine—a newly crafted month-long class meant to motivate our travels between bench and bedside—generated particularly unfavorable feedback sessions, and anonymous online forums gave credence to curriculum designers' anxieties.

It was certainly no simple task to cater to more than 160 medical students with idiosyncratic learning styles and divergent academic expectations. Some of my classmates yearned to do meaningful work overseas, while others savored each moment spent with their pathology textbooks. And we had less time to explore our interests. But true to the Harvard system, evidence-based changes were made in real time in an effort to appease the majority. At the drop of a feedback session, class schedules shifted and physiology quizzes switched from in-class to take-home.

By the end of first year, we'd been hit with as many integrated experiences as our professors could devise names for, from focused exercises to integrated case reviews to the particularly ambitious clinical-pathological-microbiological conferences. But the true test of the curriculum's success was our growing ability to make the connections organically, and for ourselves.

One spring day, a lecture on HIV treatment options followed one on the cellular biology of HIV invasion. That afternoon, we met a patient I'll call Rita, an HIV-infected African American woman in her early forties whose illness had visibly aged her. She sat in a chair that faced the small classroom and told us her story, her sometimes garbled words tumbling out of her mouth as if she had no power or desire to curb them.

I wondered which drugs she was taking, and how difficult it was for her to adhere to the complicated regimen. How had her body responded to the infection given her genetic makeup, and what would that response mean for her son, who also carried the virus? How had her experiences led her to educate others about the disease with such humor and flair?

Hands shot up in the small classroom that afternoon, propelled by lessons learned that morning and throughout the year. Talking with Rita about these issues was a far cry from our initial bumbling interactions with Stan the simulator, and the reasons for this went well beyond the fact that Rita was not fashioned out of plastic. This time, we were asking our own questions, connecting the dots for ourselves. Our hours spent poring over books and bodies converged in the guise of this small, earnest woman. Rita saw educating as her moral imperative. It was ours, then, to learn. ■

Ishani Ganguli '10 worked as a staff writer for The Scientist *before matriculating at Harvard Medical School.*

An innovative clerkship immerses third years in clinical care, introducing them to medicine and, often, to themselves. *by* ANN MARIE MENTING

holistic learning

HE PALED SLIGHTLY. IT WAS NEARLY IMPERCEPTIBLE, JUST AN infinitesimal ebb of healthy color. Perhaps it was made more noticeable because his eyes had changed, too, a slight distance slipped into what had been a bright and engaged gaze. And while the torrent of conversation continued, Peter Liang's words now carried a film of pause.

"It was one of the strongest relationships I've had with a patient," say Liang '09. "Of course, that made it much more difficult when she passed away."

Confronting the death of a patient is rarely easy for a physician, but for a medical student—fresh to the daily drama of the healing profession—it can imprint deeply. Students are often left alone to work

TAKING THE LONGER VIEW: The longitudinal clerkship program at Cambridge Hospital gets high marks from participants such as Peter Liang.

PHOTOS FOR THIS STORY: GRAHAM GORDON RAMSAY

The challenge was to establish continuity as the [illegible] that emphasized a longitudinal approach.

through the sadness, frustration, and fear of such a loss. Or they seek support from peers who are groping their way through the same experience. But Liang and the other third-year students in the Harvard Medical School–Cambridge Integrated Clerkship (CIC) have a support network of preceptors, administrators, and staff physicians that is wide, deep, and so invested in mentoring that the students' traumas and triumphs are shared. The CIC builds community, an extended family, whose members are committed to—and even thrilled by—the practice of effective, humanistic medicine.

All the Difference

Liang had met the elderly woman, we'll call her Betty, in an early medicine clinic he had attended as one of eleven third-year students in the past year's CIC. His preceptor had thought Betty would be a good patient for Liang to follow; her diabetes, dialysis, and end-stage renal disease would challenge him, as would the unexpected medical issues that were bound to crop up.

"I knew her history was complex," Liang says, "but when we met, her primary complaint was severe cramping." Betty had also developed diarrhea—a condition that prompted her to stop going to her dialysis sessions.

"I researched the side effects of her medications and found that what she was taking for cramps could cause diarrhea. I told my preceptor what I had found, and we stopped the medication."

Betty's bout with diarrhea ended; Liang had helped her overcome a problem that, while not medically as serious as her other problems, had been important to her.

"It drew us together," Liang says. "Betty seemed to trust me more. It was encouraging to be able to help her in a real way."

Establishing relationships that allow students to address their patients' medical needs, both grand and humble, is an integral objective of the CIC, a 12-month immersion in core clinical medicine for the School's third-year students. The program replaces the traditional sequential clerkship model with a longitudinal experience that emphasizes progressive professional and personal development.

Conceived of as a complete redesign of the principal clinical year, this innovative clerkship brings small bands of the School's third-year students into the only public health care system affiliated with Harvard Medical School—and into the heart of contemporary health care. Working and learning together under the guidance of attending physicians, the students are schooled in the art of doctoring in a way that, until recently, was considered too cumbersome and costly to implement. But early returns show it may be one of the better methods for building a new doctor, one ready to meet the challenges of clinical medicine in the twenty-first century.

In with the New

The third year of HMS usually finds students migrating from hospital to hospital for stints in a range of medical specialties. Every few weeks, the students move to a new clinical venue, a peripatetic educational experience that often stymies their efforts to establish substantive relationships with faculty and patients. This fragmented sequential model also presents obstacles to School faculty, making it difficult—perhaps even unappealing—to integrate the different learning experiences they offer students.

When HMS faculty and administrators began deliberating the contents of the School's curriculum reform, they placed the revamping of the principal clinical experience high on their project list. This urgency was in large part spurred by results of an internal evaluation that found the School's clerkships needed to be revised to better address the changing landscape of medicine and health care.

But it was also nudged by the concern growing among faculty, especially those within the Academy at HMS, an organization that fosters excellence among the School's faculty, that traditional sequential clerkships no longer produced students who were broadly skilled in the core competencies of the many medical disciplines. Without a broad skills base, they worried, students could not meet the health care needs of today's society.

The challenge, as they saw it, was to establish continuity as the organizing principle for a new model of clerkship. Developing clerkships that emphasized a longitudinal approach would allow medical schools to provide a patient- and learner-centered environment that fostered a continuity of patient care, a continuity of curriculum, and a continuity of supportive supervision.

This challenge was given form by David Hirsh, an HMS instructor in medicine, and Barbara Ogur, an assistant professor of medicine at the School. They crafted an integrated clerkship that replaced the traditional rotation scheme with a yearlong immersion in patient care. The CIC, as it quickly was dubbed, launched as a pilot program in July 2004.

Based at Cambridge Hospital, an HMS-affiliated teaching hospital that is part of the Cambridge Health Alliance regional health care system, the CIC is the School's longest running revised clerkship program. Since it was piloted, the CIC's longitudinal model has been modified and adapted for use by Beth Israel Deaconess Medical Center, Brigham and Women's Hospital, and Massachusetts General Hospital. These programs are leaping quickly from infancy to adulthood: Beginning with the Class of 2010, the new clerkships will be the standard third-year experience.

The CIC pilot hosted eight students who had been randomly selected from 18 volunteers of the 189 rising third-year HMS students. By July 2007, the Cambridge program had berths for 12 students who, thanks to the enthusiastic reviews from past participants that have boosted the program's popularity, were selected from a pool of nearly 30 volunteers.

In the CIC, students have close, continual contact with a panel of patients, serving as their patients' health care companions while simultaneously learning to become their patients' health caregivers. By navigating the system with their patients, the students gain a ground-level perspective of the health care system and a longitudinal perspective of caregiving. And they learn the large and small details of clinical medicine from the very staff physicians who provide their patients with care in internal medicine, neurology, obstetrics/gynecology, pediatrics, and psychiatry. The students also are responsible for patients in the radiology and surgery units, with their surgical experience augmented by a period of working directly with an attending surgeon.

To develop their clinical skills, the students pair with preceptors in each discipline and work in the preceptors' respective clinics for five- to ten-hour periods every week or two. The process allows the students to aggregate information and experience over time and under the supportive supervision of senior physicians.

GOT IT COVERED: A young patient at the Cambridge Health Alliance's East Cambridge Clinic meets with HMS student Liang for follow-up care for an injury.

This working and learning relationship firmly places each student in partnerships of care for their patients. Encouraged to seek resolutions to their patients' medical issues, the students question and evaluate patient diagnoses and treatment plans during rounds, during case-based tutorials with peers and preceptors, and through investigations of the medical literature and self-directed learning projects. As Liang found when caring for Betty, these collaborations are both medically and educationally rewarding.

"By accompanying our patients on visits with their doctors, we're able to understand more what it means to be a patient," says Liang. "That helps us appreciate each patient as a person rather than just as someone with a medical ailment."

TEACHABLE MOMENT: Clerkship students are encouraged to take time with their patients so they can deliver care that engages, teaches, and reassures.

Gloria Hou '08, another clerkship student, would agree. "I have worked with my pediatrics preceptor as she cared for patients who are the children of children she took care of years ago. She knows their social history, understands what's going on with the family, and feels like it's her job to deal with not only their direct medical needs but the social aspects of those needs, too. Such experiences have helped me learn what medicine is really like."

Liang's and Hou's observations give credence to the fostering of the "professional perspective and reflective practice" that CIC creators Ogur and Hirsh describe in the goals they set for the program. But building these sorts of connections while also fulfilling the academic demands of a third-year medical student can take its toll.

"We were told that our panel of patients would have between 70 and 80 people," says William Soares '09, another clerkship student. "I naively thought I could get to know that number of people well and still keep on top of a full curriculum. But it was incredibly difficult to keep up. I now know I must decide which patients are important to follow closely and which might not need me as much. To serve my patients well, and to do well myself, I've learned I have to balance medicine with life."

Let's Talk

Learning to achieve such a balance is a goal that is unwritten, but not overlooked, in the CIC structure. Nurturing each student's progress and well-being is integral to the program and is tended to not only by the preceptors but also by Ogur, Hirsh, and the CIC's administrator, Wendy Gutterson.

"Students can come in and talk about anything they want—from why they're not getting enough sleep to whether they should attend a patient's funeral—and we work through their concerns with them," says Gutterson. "This is an incredibly intense and formative year for the students so we do what we can to help."

Most of these conferences occur in a pocket of an office situated off a large room in one of the hospital's satellite buildings. Ogur, Hirsh, and Gutterson share the office; the students share the large room. Coming up with this home-away-from-home space for the students was not easy—like most urban medical institutions, Cambridge Hospital continually confronts space challenges—but it was considered essential.

"Senior management wanted to provide the students with a place of their own," says Gutterson. "They worked hard to find space and to make the capital investments that would give the students a valuable study space and a place to gather." That space houses desks and computers for the dozen students as well as a library of shared texts, a conference table, and an overhead projection system that the students use to present cases at the weekly tutorial sessions. The space also boasts a small kitchen; a sofa, handy for catnaps; and several oversized plastic bins of munchies.

The solidarity cultivated in this room benefits not only the students but the program, too. "Our conversations with the students are critical to the program's development," says Gutterson. "For example, their comments led us to create a more integrated pediatrics learning experience. In addition to following pediatric patients to psychiatry clinics, students now learn about

This led to an innovation that has been circles: an electronic notification system.

developmental issues from a team of physicians from pediatrics, psychiatry, and neurology; observe the interactions of children at local community day care centers; and discuss expected and unexpected issues in normal development during a tutorial session. Everyone agrees it is a stronger educational experience."

On the Same Page

This openness to new ways of doing things led to an innovation that has been garnering attention in non-education circles: an electronic notification system. Since CIC students are expected to follow their patients on all scheduled visits and, as possible, to consultations, admissions, deliveries, surgical procedures, and rehabilitation visits, there needed to be a process for informing them quickly of their patients' peregrinations. So program administrators, together with the alliance's information technology group, developed a pager system that gleans information from an electronic registry.

The registry integrates the computerized scheduling, record keeping, and admissions systems in place throughout Cambridge Health Alliance. Students enroll each of their patients in the registry and are then paged every time one of those patients keeps an appointment, cancels an appointment, shows up in the emergency department, or has any other interaction at one of the alliance's sites.

"In traditional clerkships," says Liang, "you know exactly when you're going to be in the hospital and for how long. We carry our pagers with us at all times and, with some exceptions, when I get paged, I'm going to answer it. Although I try to make as many of the calls as I can, I've learned to balance those calls with my scheduled clinic duties, my study demands, and the time I need to spend with other people. Even if the call is not something I'll go in for, at least I know one of my patients was in and why."

This wealth of patient information generated an unexpected consequence: Physicians at Cambridge Hospital were eager to be included in the system. So the alliance made the notification tool available to practitioners throughout its hospitals and primary care practices, perhaps the first health care group in the nation to have this capability.

High Marks

The CIC story has representatives from other medical schools seeking out the program's administrators. And the fact that the program recently brought the alliance the top honor for medical education reform from the National Association of Public Hospitals and Health Systems should keep those cards and letters coming.

But to satisfy decision-makers—and themselves—on the pedagogic merits of the new approach, Ogur and Hirsh teamed with Edward Krupat, director of the School's Center for Evaluation, and David Bor '75, chair of its Integrated Clerkship Steering Committee, to take an empirical look at the achievements of the program's first cohort of students. Their findings, presented in the April issue of *Academic Medicine*, were encouraging.

The CIC students performed at least as well as students in traditional clerkships in tests of content knowledge and skills, such as the tests issued by the National Board of Medical Examiners and the fourth-year Objective Structured Clinical Exam. The CIC students retained content knowledge better, however, than students in traditional programs, scoring higher on year-end measurements of comprehensive clinical skills.

The CIC students also were more likely than traditional clerkship students to see patients before diagnosis and after discharge and to receive feedback and mentoring from experienced faculty. Perhaps best of all, CIC students were more satisfied with their curriculum and felt better prepared for the challenges of patient care, including involving patients in decision-making and understanding the social contexts affecting their patients. Members of the most recent CIC cohort concur.

"One of the biggest differences I find when I talk with my classmates," says Liang, "is that they feel exhausted and even disillusioned with medical school while I feel excited and am looking forward to what's next. The program has made a huge difference in my morale and energy level—and my attitude."

"I think this is a humane way to learn medicine," says Hou, "one that has allowed me to move forward with my idealism very much intact. And that's incredibly important, something test scores just can't capture." ■

Ann Marie Menting is associate editor of the Harvard Medical Alumni Bulletin.

TOT-SIZED TUTOR: The simulated infant that is the smallest member of the School's mannequin family offers students a window onto the physiology of babies.

With their earliest patients made of silicon and circuitry, Harvard medical students are finding it easier to first do no harm. *by* MARK BAARD

sim city

THE PACKING MATERIAL HAD BARELY BEEN BRUSHED FROM STAN, THE School's new simulated patient, when Nancy Oriol '79 found herself heading up a tour of the laboratory the mannequin would call home. A group of prominent doctors had come to see Stan and to witness firsthand the role that simulated patients could play in presenting medical students with realistic clinical challenges. Oriol, dean for students at HMS, offered to stage a demonstration of Stan in clinical crisis. After the group examined the patient and reached a diagnosis, one of them gamely stepped forward to intubate the patient. The situation quickly became tense, however, as Stan's tongue

PHOTO: CHRISTOPHER HARTING

The physician struggled to guide the tube breathing became increasingly labored.

and larynx began to swell. The physician, drawn into the urgency of the moment, struggled to guide the tube into place while his plastic patient's breathing became increasingly labored. Sweat began to trickle down the physician's face; Oriol watched it bead and drop off the tip of his nose.

"I suddenly remembered the supply of oxygen we kept handy for demonstrations," she says, "and decided to move closer to it—and to be ready to put it to use. I was afraid our simulated patient would have to make way for a real one."

Such an intense reaction to the simulator reveals the power of the new teaching tool. "If a simulator can engage an experienced physician," says Oriol, who is also an HMS associate professor in the anesthesia department of Beth Israel Deaconess Medical Center, "it can definitely cause students to pay attention. Students find working with the simulators to be a particularly acute experience because they know they'll likely be treating real patients under similar circumstances."

HMS became one of the first medical schools in the nation to make medical mannequins available as a student teaching tool for both basic and clinical science when Harvard faculty at the Cambridge-based Center for Medical Simulation began offering this leading-edge technology to students as early as 1997. But in the curriculum overhaul that the School introduced this past year, all incoming students at HMS will start their education working on patients made of silicon and circuitry. To make learning as dynamic as a real clinical experience, the School is using its lifelike simulators to bring patients' cries, medical complications, and missed diagnoses into the first-year students' introduction to medicine.

How to Spell Relief

In the simulation classroom, as in real hospital settings, things don't always go smoothly. Doctors—and doctors-in-training—make mistakes in the heat of emergency care. A constellation of symptoms may mask the underlying cause of a crisis. A patient's clinical course can change suddenly. And patients, including Stan, named for his role as standardized patient, can be hard to manage.

"Novices don't realize how hard it can be to think through a diagnosis while they're trying to communicate with the patient," say Oriol. "The physician's instinct is to want to make patients feel better, but in trying to make them feel better, we can also harm them."

Konstantina Stankovic '99, who encountered Stan during her student years, knows firsthand how the sounds and readings that Stan and his simulator buddies generate can create powerful and emotional learning experiences for health care professionals preparing for their initial encounters with real patients.

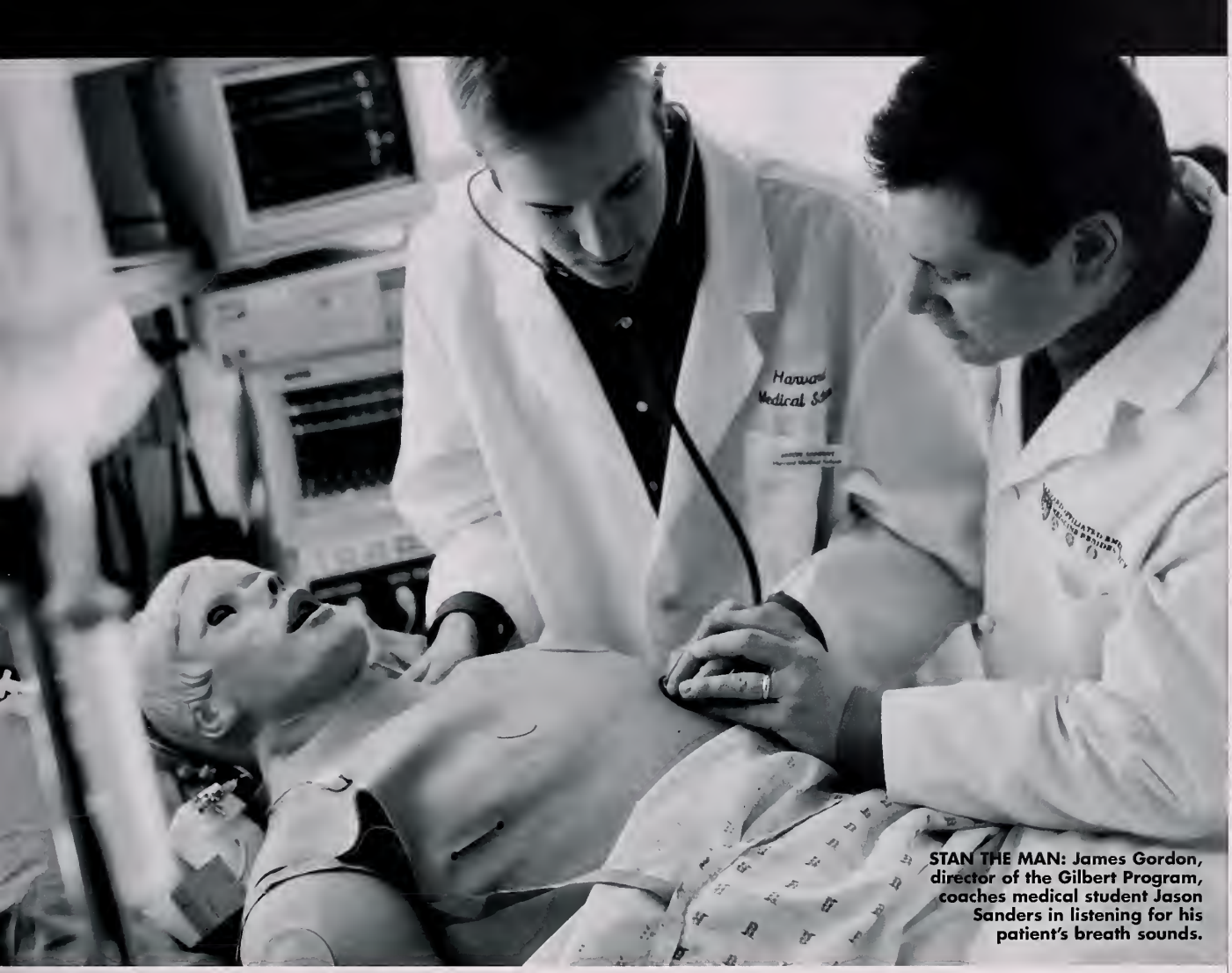
Stankovic recalls being a member of a team of medical students who were scrambling to help Stan as he cried, "It hurts so much! They said you'd give me something for the pain!"

Her team, working as part of a course organized by faculty anesthesiologists John Pawlowski and Martha Gallagher, diagnosed a twisted bowel and elected to administer a significant dose of morphine for the pain. But Stan suddenly stopped breathing. A member of the team grabbed an ambu-bag and used it to get Stan breathing again while another intubated him. His life was saved—and the relieved team took a collective deep breath. "Working with Stan sharpens your ability to sort through a wealth of information, while dealing with the patient's immediate needs," says Stankovic, now an otolaryngologist at the Massachusetts Eye and Ear Infirmary.

The Family of Stan

The HMS community's original patient simulator, purchased in 1993 by a consortium of HMS anesthesia chiefs, has become an old-timer in the patient-simulation business. Even a newer model, housed on the medical school campus since 2001, is showing signs of wear. His tongue has been tattered as a result of countless probings by instrument-wielding students. And replacement skin is always available to repair an arm that has taken too many needle jabs. His looks betray the years even more than the worn parts: Stan is a barrel-chested fellow, the 1950s masculine ideal—think George Reeves playing Superman on television.

To reduce the demands on Stan and to keep in step with evolving technology, additional mannequins have been purchased as part of the formation of the G. S. Beckwith Gilbert and Katharine S. Gilbert Medical Education Program in Medical Simulation at HMS in 2003. With the Gilberts' generosity, Stan has been joined by four



STAN THE MAN: James Gordon, director of the Gilbert Program, coaches medical student Jason Sanders in listening for his patient's breath sounds.

identical adult males and an infant simulator. A child simulator is also housed in the Gilbert laboratories, as part of a long-standing partnership with the Harvard anesthesia chiefs at the Cambridge center.

Currently retailing between $40,000 and $250,000 each, the recent generation of patient simulators can draw upon an extensive repertoire of physical, biochemical, and verbal responses to the care that students might administer. Tongues can swell; airways can alter to support, or thwart, endotracheal intubation; and pulses at the mannequins' wrists, necks, and groin areas can vary or coordinate with the ECG and systolic blood pressure. The simulated patients can support vigorous CPR and can accommodate defibrillator paddles, which can be placed on metal contacts that dot their chests. The mannequins' pupils can constrict in response to light, and oximeters attached to plastic fingertips convey readings to monitors positioned near the simulators' stretchers.

The baby member of the School's simulator family has some extra bells and whistles—and lights—useful to depicting conditions that could distress an infant. When he's not in trouble, he lies docile in his bassinet, a chubby infant in a hospital-issued knit cap. His little belly swells with each breath. He blinks, cries, coos, and even wets. He is certainly easier to manage than a live, squirming baby. Yet, like a real infant, the baby simulator can turn blue in a twinkling, cueing students to his acute need for oxygen. And even though the indigo glow comes from a row of tiny bulbs lining the baby's mouth, the sight is enough to panic medical students.

Behind the Green Curtain

That level of emotional engagement is exactly what instructors using the simulators are trying to achieve, says James Gordon, director of the Gilbert Program and an HMS assistant professor in Massachusetts General Hospital's Department of Emergency Medicine. The program, which aims to foster experiential learning in a no-harm-done environment, oversees the integrated full-body simulator laboratories that house the mannequins on campus. The laboratories wed basic and clinical science and together can accommodate a class of 160 students on any day of the year.

In the laboratories, student–Stan interactions are orchestrated off-stage. Hidden from student eyes by a curtain, an instructor—who typically doubles as the voice of the patient—watches monitors that show the

PHOTO COURTESY OF JONESFOTO, INC

PHOTO: LIZA GREEN

BREATH OF FRESH AIR: Nancy Oriol, the dean for students, introduced the original Stan to Harvard Medical School.

effects that various therapies have on Stan and can determine the changes that occur to his vital signs as a result of receiving, for example, an injection. With his blinking blue eyes, convincing skin texture, and varied voice inflections, Stan does his best to deliver the dose of reality that students need to understand the clinical context and to rehearse interactions with patients.

"It's a way of making learning more effective," Gordon says of the combination of traditional instruction and Web-based information technology that characterizes the teaching approach. "Students using the simulators integrate and remember the material because of the powerful way it is presented. Imagine, for example, that Stan complains that his chest hurts. As part of the students' session with Stan, you can pull up a computer video of an angiogram that shows a blocked coronary artery. Bringing real images into the simulated clinical interaction is one way to give students an immediate opportunity to integrate relevant anatomy and radiology with the patient's clinical problem."

On a whiteboard above Stan, Gordon draws a diagram illustrating a circumplex model of emotion, a broad representation of human affect that cognitive psychologists have described. Students in a lecture hall, he says, are often in a deactivated state, which inherently limits the power of the lesson.

Virtual Reality

The patient mannequins aren't the only form of simulated learning that Harvard Medical School students receive. On-screen virtual patients, which can be coupled with mannequin-based sessions, provide a two-dimensional electronic layer to the increasingly varied experience now available to the students.

While Stan can help students learn how to interview a patient in a doctor's office or resuscitate a patient crashing in the emergency room, an on-screen patient can simulate the long-term care of the same patient with a chronic illness. A student might diagnose a virtual patient with diabetes, for example, and then visit with that same patient as the disease progresses over many years, causing kidney dysfunction and heart disease.

"Medical students and even residents aren't getting as much access to real patients as they used to," says Grace Huang, an HMS assistant professor of medicine at Beth Israel Deaconess Medical Center (BIDMC). "Simulations expose students to conditions they might never see in their residencies."

Huang is working on the Virtual Patient Project, a program at BIDMC that focuses on long-term care and clinical interactions with patients. So far, she and her colleagues have amassed case histories of more than 50 virtual patients who exist only on a hard drive.

"The Virtual Patient Project allows us to give students longitudinal views of patients," says Huang. "Nine years are compressed into a single experience."

More than a mannequin and less than a robot, Stan has served as something of an ambassador for medicine.

But simulations such as those provided by Stan put students on alert by generating anxiety and surprise. "As often as possible," Gordon says, circling the word "activated" on the whiteboard, "*that's* where we want to be."

Oriol has taken great satisfaction in witnessing the effect that the simulators can have on student learning. When, for example, one of the students from the Class of 2010 was asked to interview a real patient during Patient-Doctor I class, Oriol says, "he did a beautiful job. His classmates were blown away. They asked him where he had learned how to do that, and he just shrugged and said he'd been practicing with the sims."

Pinch Hitter

More than a mannequin and less than a robot, Stan also has served as something of an ambassador for medicine, playing a key role in several programs designed to present high school and college students with an authentic medical instruction experience and an opportunity to increase their medical literacy. Oriol says that feedback from participants in these programs, together with that gathered from HMS faculty and students who had experience working with Stan, has helped guide the development of a new course for HMS students, Introduction to the Profession. Part of the School's revised curriculum, the course is now the entry point for each incoming class.

Oriol has been delighted with the response of the first class to go through the new curriculum. Each member of the class experienced ten hours of simulator time by the midway point of the first year, believed to be the most in the nation. In addition, says Oriol, "We've estimated that about 30 of the 166 members of the Class of 2010 came to the simulator labs on a weekly basis during their first year," she says. "You have to remember this is voluntary, above and beyond what's expected of them."

That time spent with Stan is becoming more precious as shorter rotations and in-patient care shifts mean that many medical students might never see an asthma attack or a croupy baby before they graduate.

Simulated patients also help ensure that a real patient's heart attack will not be the first one a young doctor has ever responded to—or even witnessed. "In the simulator lab, we can teach you more, sooner," says Gordon. "Here, there's always a patient waiting for you." ■

Mark Baard is a freelance writer based in Milton, Massachusetts.

Huang's interns at BIDMC can practice taking down patient histories, diagnosing chronic illnesses, and prescribing treatments, all while working with screen-based virtual patients. If one of the virtual patients becomes sick as a result of a missed diagnosis or bad clinical decision, for example, the student will get an earful from the patient. A video of the patient, portrayed by an actor, will show her after she's checked into the hospital, to underscore the potentially serious consequences of making a bad call.

Most of the virtual patients Huang uses are text-based, consisting of multiple-choice questionnaires and decision trees. In addition, Huang weaves interactive pathophysiology diagrams and tutorials into the virtual patient lessons.

Harvard medical students can also learn from the Human Systems Explorer project, created by Michael Parker, an HMS assistant professor of medicine. Parker's project draws on the full power of the Web—animation, simulation, and interactivity—to present students with an accurate portrayal of functioning human systems. The computer-based tool layers sophisticated computational and mathematical algorithms on the movement and sound capabilities inherent to the Web to create realistic time-dependent phenomena. The system can, for instance, show how the heart's pressure, sounds, and cycle coordinate. And its interactivity lets students vary physiological parameters, allowing them to change lung volume over the entire physiological range while witnessing the forces that result at any given volume. ■

ILLUSTRATION: PHILIPPE LARDY

the VISION

A physician who conducts music reflects

of MUSIC

on the healing powers of mingling the senses. *by* SAMUEL WONG

How might we harness the associative power of music and

When Edgar Degas could no longer see well enough to paint, he turned to sculpture, relying on a newfound tactile keenness. When French composer Gabriel Fauré's hearing became deranged, he cried, "I only hear horrors." Ludwig van Beethoven persisted in writing symphonies yet confided to his brothers, "I am deaf...how would it be possible to admit the deficiency of a sense I ought to possess to a more perfect degree than anybody else?"

A painter loses his eyesight; a composer loses his hearing. How might we treat and rehabilitate such patients? How can we take advantage of the healing mechanisms of neuroplasticity and sensory transfer to lift the spirit of a devastated artist? How might we harness the associative power of music and the visual arts to amplify one sense so as to replace the loss of another?

I have spent my professional life immersed in issues of sight through my work as an ophthalmologist and sound through my work as a symphony conductor. I have enjoyed inhabiting both of these worlds, so it is perhaps not too surprising that I would be captivated by thoughts of how their intersection might benefit others, particularly people who have lost the use of a sensory capacity that is vital to their creative expression.

My interest in exploring these possibilities has led me to probe the physiological aspects of synesthesia, a perception by one sense, such as vision, through stimulation of another sense, such as hearing. Could our understanding of how the brains of synesthetes—and nonsynesthetes—respond to sensory stimulations give us clues to therapies for those who've lost a perceptual window to their worlds?

Coda Blue

Synesthesia derives from the Greek terms *syn*, meaning together or with, and *aesthesis*, meaning sensation or perception. The scientific community became aware of this condition in the late 1880s when Sir Francis Galton, a half-cousin of Charles Darwin, wrote in *Nature* about individuals who saw colors when viewing letters of the alphabet or hearing music.

Synesthesia can find expression in several ways. In music-color synesthesia, individuals experience tones or sounds in response to colors or shapes. For those with ordinal-linguistic personification, ordered sequences, such as letters, numbers, days, or months bear distinctive personalities: Wednesdays, for example, might be perceived as an impish adolescent. Spatial-sequence synesthetes can experience three-dimensional perceptions; months may appear near the ground. In the rarest form, lexical-gustatory, words cause taste sensations in the mouth—"echo," for example, may always elicit the taste of buttered toast—while in the most common form, grapheme-color, thought to be experienced by 68 percent of synesthetes, letters or numbers have identifying colors.

Although the prevalence of synesthesia is imprecisely known, researchers estimate that, at minimum, it appears in one in twenty thousand but that certain types manifest in one of every two hundred people. It is a lifelong condition, possibly heritable, and is remarkably consistent: If the letter M is perceived to be purple, it will always be purple. This latter trait has been perhaps most famously expressed by Vladimir Nabokov. "In the green group," he wrote, "there are alder-leaf *f*, the unripe apple of *p*, and pistachio *t*....In the brown group, there are the rich rubbery tone of soft *g*, paler *j*, and the drab shoelace of *h*."

Some musicians strongly associate sound with color. For the composer Nikolai Rimsky-Korsakov, the key of C major was white, while the key of B major was a gloomy steel blue. Franz Liszt exhorted an orchestra, "That is a deep violet, please, depend on it! Not so rose!"

Tone Poems

My interest in synesthesia and the brain led me to functional MRI. By showing neurons at work, it allows us to spy on artists' brains and to watch their creative processes unfold. So, in an attempt to understand what parts of my brain engage when I listen to, read, think, or translate a piece of music, I submitted myself as a candidate for an experiment. While on a conducting assignment, I spent a week rehearsing an orchestra in Beethoven's *Fifth Symphony*. Between rehearsals I had my brain scanned while undertaking five different activities: listening to a recording of Beethoven's music; thinking of the music but in silence, with my eyes closed; reading a score of Beethoven's *Fifth* in silence; moving my fingers as if playing the symphony on the piano, again in silence; and thinking of the motions I would use when conducting this music.

The functional MRI revealed differences in the responses in my auditory and visual cortices, as I expected. But dramatic differences also appeared in the associative areas of my brain, in the V4 region, the temporoparietal-occipital junction, the corpus collosum, and the limbic system, regions whose interplay contribute to our perception of color. The experiment showed me how incredibly rich and varied the musical experience can be, a knowledge that gives me a greater understanding for the diversity that audience

the visual arts to amplify one sense so as to replace the loss of another?

response can take. It also provided me a startling glimpse of the responses that synesthetes—whose perceptual pathways may be differently wired or, possibly, less disinhibited—can enjoy.

Our growing knowledge of functional brain anatomy will allow us to continue gathering clues about artists' creative processes. In the same way, we can begin to capture the associative power of music and painting into art therapy. Some blind patients, for example, have found comfort in musical training, which has inducted them into a rich sonic world of subtle beauty. Visual patterns can be transformed into sound patterns for recognition and appreciation. Such synesthetic techniques can be helpful for patients with sensory loss.

Breaking the Sound Barrier

I often find comfort in late-night music. In Gustav Mahler's work I hear the end of mankind, as did the late Lewis Thomas '37, an observation recounted in his book *Late Night Thoughts on Listening to Mahler's Ninth Symphony.* But in Beethoven's *Ninth*, I hear and see a fist-shaking, gravity-defying, deaf-be-not-proud maestro and the indomitable spirit of mankind.

My role as a conductor allows me to imagine the power offered by a synesthetic world. Sometimes, when I'm conducting an orchestra, I'll close my eyes, and memories of past performances, a teacher's lessons, landscapes, colors, and the faces of musicians all flash together. Then the images disappear as quickly as they came, as a musical note evaporates in thin air after it is made. Only its memory and aftertaste linger in the mind, sometimes for years or even a lifetime.

Moving from the concert theater to the operating theater, I am often struck by how the brinkmanship inherent in the work of conductors also exists in the work of surgeons. When a conductor closes his score and his eyes to conduct a searing performance of *The Rite of Spring*, he faithfully reproduces Igor Stravinsky's carefully calculated arrhythmias. One misstep, one deviation of a few *milliseconds*, and the fine synchronization and ensemble are threatened. Drums may lose their entrainment and rhythms unravel.

During an eye operation, if a surgeon presses a few *micrometers* too deep, a phaco tip may penetrate the posterior lens capsule, and lens fragments may fall back to the retina. Fortunately, such complications rarely occur in either the musical or surgical endeavors.

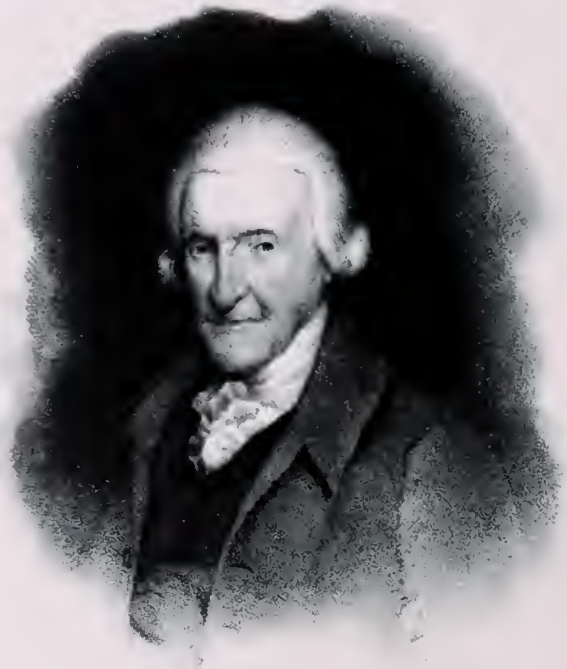
The accolades in both fields, when they occur, can be palpable. The applause in the clinic can be as resonant as that in a concert hall, though often quiet: The gratitude of patients shines through their eyes when, after cataract surgery, they relive the wonder of unimpeded vision.

It would give me great joy to be able to help artists regain critical sensory mechanisms they have lost, much as my surgery can help those encumbered by cataracts regain their view of the world. Our growing understanding of the neuromechanisms of sensory perception may make this possible one day. By learning how the brains of synesthetes process sensory stimulation and by comparing that information with that derived from experiments similar to my own, we may be able to rehabilitate those who—through stroke, aphasia, or other devastations to their neural landscapes—have lost the ability to make those connections.

To ensure that research and interest in "music medicine" grows, I have launched the Global Music Healing Institute, a foundation engaged in studying the effects of music on the autonomic system, on mood, and on speech and cognition. It is my hope that by stimulating research, public awareness, and interdisciplinary knowledge of the medical benefits of music, this organization will help build bridges that will allow patients—perhaps even a Degas or Fauré of today—reconnect with the perceptions and functions that help make their lives full. ■

Samuel Wong '88 has held music directorships in New York, Hong Kong, Hawaii, and Michigan. He has led the Royal Philharmonic on tour and recorded two award-winning discs with the Hong Kong Philharmonic. He now practices ophthalmology in New York.

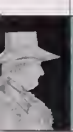
ANATOMY *of a* Doctor's Life



E. A. Holyoke

IMAGE: COURTESY OF THE NATIONAL LIBRARY OF MEDICINE

THE NEWS TOLLED THROUGH THE CHILL air of the late winter dusk: Edward Augustus Holyoke was dead. The church bells were only the first of many to carry the message. Days later, the *Salem Gazette* would tell its readers that on the last day of March in 1829 their town had lost "the skilful Physician, the learned Philosopher, the active Philanthropist, and the Good Man" who had lived in their community for 80 of his 100 years.



Harvard awarded its first medical degree, an honorary one, to a

BIRTH PLACE: Its distinctive tower capped by a weothervone, Horvard Holl, shown here in o 1795 wotercolor by Houdin Dorgemont, housed some of the eorly gotherings of students of the Medical Institution of Horvord University, the nome by which Horvord Medicol School wos first known.

IMAGE: COURTESY OF THE HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE

Two weeks earlier the *Gazette* had posted a short item warning readers that the "venerable" man was sick and his recovery doubtful. Now it was time for the community to pay its respects to Holyoke: a son of Edward Holyoke, a clergyman who had served as Harvard's president in the late 1730s; a founder and the first president of the Massachusetts Medical Society; a charter member of the American Academy of Arts and Sciences; and the first person to receive a medical degree—albeit an honorary one—from Harvard.

In keeping with the stature of the man, a newspaper notice for the funeral invited all to gather at Holyoke's home before processing to the church. But days earlier, in keeping with the nature of the man, Salem's physicians had been invited to convene what would be Holyoke's final contribution to the advancement of medical education: his autopsy.

Cold Case

Those physicians who could attend gathered in a room as chilly as the wintry outdoors. On a table before them lay Holyoke's draped corpse.

Muffled by their cutaways and frockcoats, the men may have talked quietly as they stood around the table, smoked cigars or pipes, perhaps even fortified themselves with Holyoke's prescription of "a dram of Rum or some spirit or a Glass or two of Wine." They may have intoned a prayer or raised a solemn toast. Then one of them, with little intro-

colorful Salem physician. *by* ANTHONY S. PATTON

duction, had plunged a scalpel into the body's sternal notch. With that act, heads converged as the men leaned forward to learn the secrets of the death—and life—of their colleague and friend.

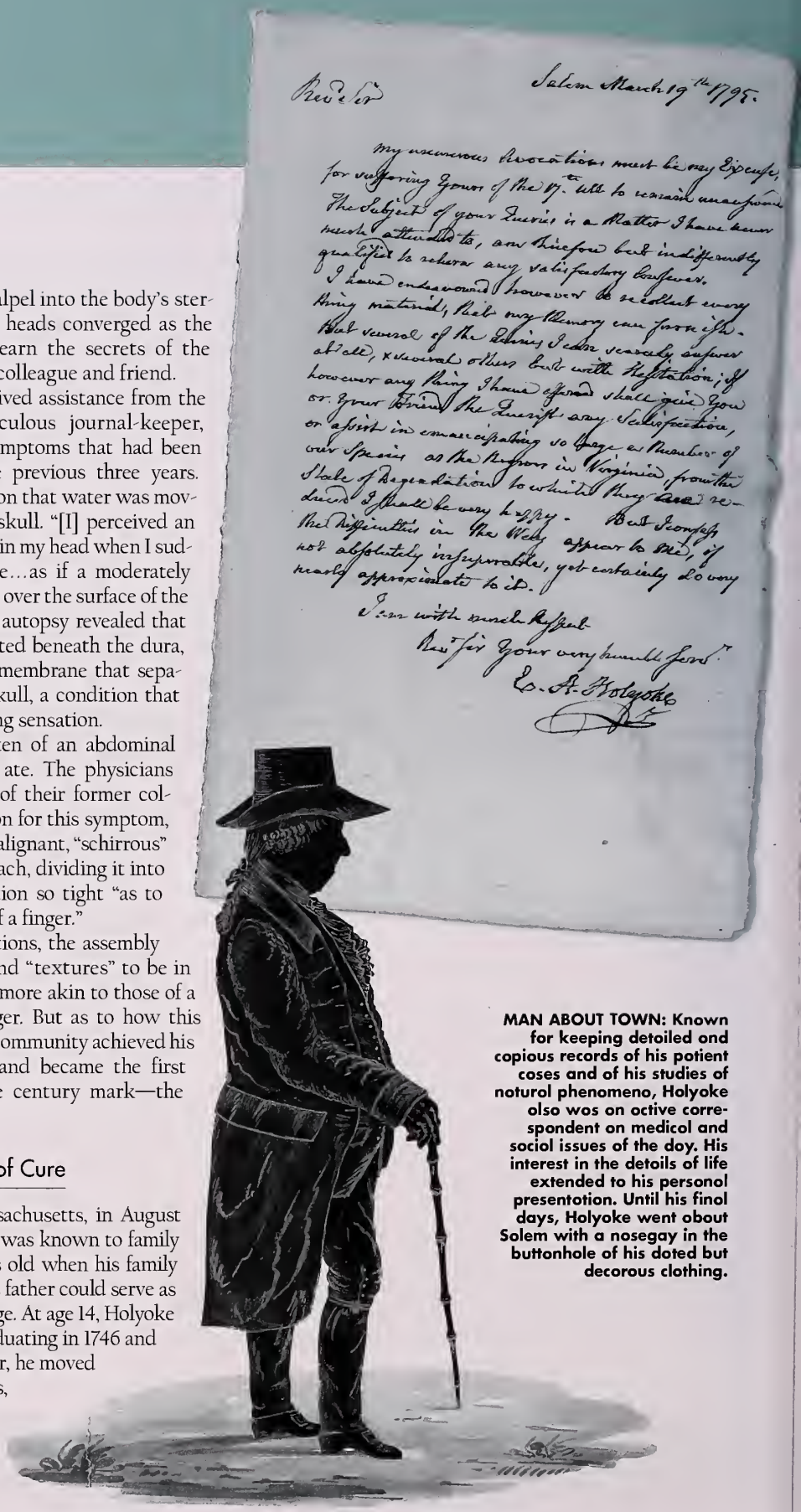
Their investigation received assistance from the subject himself. A meticulous journal-keeper, Holyoke had described symptoms that had been troubling him during the previous three years. These included the sensation that water was moving back and forth in his skull. "[I] perceived an odd and unusual sensation in my head when I suddenly changed my posture...as if a moderately ponderous fluid fluctuated over the surface of the brain...." And indeed, the autopsy revealed that serous fluid had accumulated beneath the dura, the thick parchment-like membrane that separates the brain from the skull, a condition that likely explained the sloshing sensation.

Holyoke had also written of an abdominal pain that spiked after he ate. The physicians probing the final aspects of their former colleague found an explanation for this symptom, too—a large, most likely malignant, "schirrous" ulcer that girdled his stomach, dividing it into two regions by a contraction so tight "as to hardly admit the passage of a finger."

Aside from these conditions, the assembly found Holyoke's organs and "textures" to be in a surprisingly sound state more akin to those of a person five decades younger. But as to how this esteemed member of their community achieved his extraordinary longevity—and became the first Harvard man to pass the century mark—the autopsy gave little insight.

A Cabinet of Cure

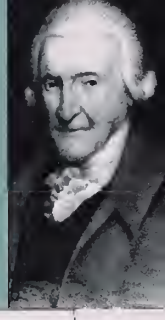
Born in Marblehead, Massachusetts, in August 1728, "Neddie," as Holyoke was known to family and peers, was seven years old when his family moved to Cambridge so his father could serve as president of Harvard College. At age 14, Holyoke entered Harvard. After graduating in 1746 and spending a year as a teacher, he moved to Ipswich, Massachusetts, where he began the study of medicine as an apprentice to Thomas Berry, a



MAN ABOUT TOWN: Known for keeping detoiled ond copious records of his potient coses and of his studies of noturol phenomeno, Holyoke olso wos on octive correspondent on medicol and sociol issues of the doy. His interest in the detoils of life extended to his personol presentotion. Until his finol days, Holyoke went obout Solem with a nosegay in the buttonhole of his doted but decorous clothing.

IMAGES: COURTESY OF THE MASSACHUSETTS HISTORICAL SOCIETY [TOP RIGHT] AND THE BOSTON MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE

From age 20, the physician made his way on foot, an effort that, by his own calculations, totaled nearly 150,000 miles.



well-respected local physician. Two years later, Holyoke relocated to Salem to set up his own practice.

At first the decision seemed unwise: Holyoke had difficulty building a patient base and so, for several years, seriously considered abandoning the town and his practice. But a fear of distressing his father—and perhaps an early showing of the patience and perseverance that would come to characterize his approach to work—held him to the place and his practice. In the decades to come, his steadfastness would be amply appreciated.

During his 80 years in Salem, Holyoke became a mainstay of the community, respected as much for his avocations as for his profession. His colleagues, for example, in their posthumous memoir—and autopsy report—of the man, described the town's indignation at the pilfering of a thermometer that had long been suspended from the doorpost outside Holyoke's home. The instrument was one Holyoke had regularly consulted as part of his long-term observation of weather conditions. The theft was "viewed as a sort of sacrilege, and it was generally agreed that it could not have been the deed of a Salem thief, for it was thought there could be none in town so base, as to not respect the property of the Salem patriarch."

Holyoke was recognized throughout town, having ministered to the residents of nearly every Salem home. In his early years, his visits were on horseback. This mode of travel, however, did not work out well for Holyoke; he could not keep his steed from slipping its bridle. So from age 20, the physician made his way on foot, an effort that, by his own calculations, totaled nearly 150,000 miles.

This man who, when seen on his way to the celebration of his one-hundredth birthday, pleased passersby with " his elastic step and cheerful looks" and "his accustomed nosegay slipped through his button-hole," was also the man who impressed young doctors with the elegant simplicity of his practice of medicine. One such protégé wrote in 1797 of a conversation in which Holyoke, while showing the young man his shop, said, "there seems to you to be a great variety of medicines here…but most of them are unimportant. There are four which are equal to all the rest, Mercury, Antimony, Bark [quinine], and Opium; of these there are many preparations, however. Of Antimony I think I have used thirty."

Although seen as a cautious practitioner, Holyoke stayed current with new modes of practice and read the latest medical literature; he was a long-term subscriber to many of the important journals published in England and on the Continent. He was one of the earliest physicians to experiment with the use of digitalis and other medicines, and colleagues acknowledged that there were "several medicines which owe their introduction into use entirely to him, and may in fact be said to have originated with him, as he was the first to settle their best mode of preparation and administration."

A Full Man

Holyoke exhibited a zest for learning and life that seemed unquenchable, even in the face of personal tragedy: He lost his first wife and child in childbirth, and eight of the dozen children born to his second wife died in their first few years of life.

In the memoir penned by his colleagues, Holyoke was described as someone who exemplified what Sir Francis Bacon had styled a "full" man, capable of speaking and writing Latin and French and "well versed in astronomy, and in the several branches of natural philosophy and theology, and the belle lettres." They wrote of how he admired the aurora borealis, compiled daily weather readings, and recorded his astronomical observations. And although they noted that he failed in his effort to correlate the prevalence of certain diseases with weather and seasonal changes, they were clearly impressed with his habit of chronicling his daily activities and observations.

Notable among his recordkeeping efforts was his work during a smallpox epidemic that threatened Salem in 1777. An advocate of vaccination—Holyoke was himself inoculated for smallpox in 1764—he was asked to head a smallpox hospital just outside of town. Here he and his staff undertook the not-always-safe method of inoculating healthy individuals using extracts from the pox lesions of recovering victims. Of the six hundred people they vaccinated, only two died.

Ten years later, Holyoke confronted a different epidemic, this time of measles. During the several days of that event, Holyoke performed yeoman's service by daily making more than a hundred visits to patients throughout town. Even during quieter periods, Holyoke was an active practitioner, averaging eleven professional calls a day. During both calamity and calm, however, he always took time to note the details of his visits to patients.

The merits of keeping complete records seemed obvious to Holyoke: "The observations of many, made at the same time, and in different parts of the country, and con-

CRACKER JACK: James Jackson, the School's second dean and a cofounder of Massachusetts General Hospital, began his career as an apprentice to Holyoke.

IMAGE COURTESY OF THE HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE

tinued for a course of years, must...doubtless be the readiest and most effectual method of furnishing materials for a history of those diseases which are either epidemical or endemical in our country." Following his own advice, Holyoke amassed 120 daybooks on his practice, each book filled with observations written in a fine hand.

Although Holyoke's dedication to and exploits as a physician and intellectual were lauded while he lived, time has suggested that his more profound and lasting legacy may be that of a mentor and a pioneer in medical education.

Bag Men

Until Harvard Medical School was established in 1782, the apprentice system was the only method of physician education in New England. Some wealthy individuals were able to travel to Europe for their formal education in the field, but most doctors were trained by apprenticing themselves to an established practitioner.

It was, and still is, a privilege to learn from a master. Indeed, even well into the twentieth century, many surgeons spent time after their training working for highly experienced and respected surgeons. In the 1930s at Massachusetts General Hospital, surgical greats such as Richard Sweet '26 and Leland McKittrick '18 spent years as "assistants" to master surgeon Daniel Fiske Jones, Class of 1896, who had, in turn, spent years working under the famed surgeon Maurice Richardson, Class of 1877. As late as the 1970s, young doctors "carried the bag" for older, successful, and experienced practitioners.

Holyoke mentored many aspiring physicians; between 1762 and 1817 he was preceptor to 35 medical men. Many of these men went on to establish outstanding professional records. James Jackson, a force behind the establishment of Massachusetts General Hospital, provides one such example. A physician acknowledged for his comprehensive grasp of the needs of medicine and medical education in the early nineteenth century, Jackson regarded Holyoke as a "glorious old master." Another of the young men who learned from Holyoke became known for a range of accomplishments, including the instrumental role he played in the founding of Harvard Medical School. That young doctor was John Warren.

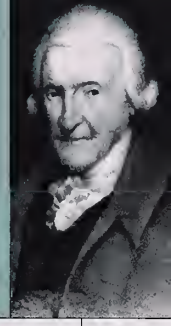
In 1773, Warren moved to Salem to study with Holyoke and to open a practice. With time, he thought, he would be able to succeed Holyoke as the town's leading physician. Things did not proceed as Warren had planned. A year had not passed before the young Warren was writing to his brother Joseph to complain that although he was busy and his practice was second only to Holyoke's in volume, he was unable to earn much income. "The people here are accustomed to being dealt with so very easy by their physicians," wrote Warren, "Dr. Holyoke having reduced fees to a very low rate and never troubled [his patients] for their accounts except when they troubled him for them."

But the onset of the American Revolution presented Warren with an opportunity. His extraordinary talents as a surgeon were recognized, and he soon was commanding hospitals for George Washington's army—and creating a name for himself as a lecturer on anatomy. His skill and knowledge in this field ultimately led to Warren's appointment as the School's first professor of anatomy and surgery and to his appointment, with Jackson, as one of the first two staff physicians at Massachusetts General Hospital.

Degrees of Separation

The end of the American Revolution ushered in a vigorous time in this country, one that Holyoke participated in

Holyoke's generosity in sharing his good fortune and talents with his students helped establish many of this country's fine medical lineages.



with verve, founding and often leading many of the new professional, cultural, and historical associations.

It was during this admirable frenzy that Harvard Medical School was born. Its origin was the result of a number of influences, including intense lobbying by Holyoke and other members of the newly formed Massachusetts Medical Society.

It is unclear why Holyoke, among the many fine men of the period, was chosen to be the recipient of the first medical degree to be issued by Harvard, although few would have denied he was a deserving candidate. As a physician, he embraced new principles and methods and put them into practice, as exemplified by his smallpox vaccination work. His skills as an observer had allowed him to connect the disappearance of the once-common "dry belly ach" complaint with the disuse of lead-containing pewter dishes. And, as a scientist, his experiments on ether and the role of evaporation in lowering temperature had not gone unnoticed.

SALEM FAILED HIM: After struggling to build a practice in Holyoke's Salem, John Warren left, a decision that proved beneficial to his career and to Harvard Medical School.

Another strong contender for the honor may have been undone by the political climate of the time. James Lloyd, perhaps Boston's most prominent physician between 1765 and 1790, had spent time at Guy's Hospital in London, where he had received training that surpassed that of almost all his contemporaries in the colonies. But Lloyd was also a moderate royalist. That politically unpopular position could have tipped the balance on this momentous decision; the degree, after all, would be conferred in 1783, just as the nation was breaking free of England. Although Holyoke was also well acquainted with the Tory crowd, in 1775 he had joined others in writing a public declaration disavowing any support of Royal Governor Thomas Hutchinson and declaring opposition to English rule.

In addition to having the right political stance for the times, the role that Holyoke's connections played in the decision to award him this degree cannot be minimized: He was, of course, the physician–son of a former president of Harvard. And, as the first president of the Massachusetts Medical Society, Holyoke worked with two of its other founding members, Warren and Aaron Dexter. These men, who represented two-thirds of the School's first faculty, undoubtedly helped influence the decision.

Climate Change

The hundred years of Holyoke's life coincided with a period of great change in the country's history. The emphasis on religion in daily life shifted, and society became more secular and tolerant. The intellectual awakening of the period saw a flowering of literature and newspapers and the introduction and acceptance of modern scientific ideas, methods, and teachings. A strong democratic society emerged, one that clearly announced its rejection of the rigid class system of its former colonizer.

Holyoke was a product of this intellectual and scientific ferment. His generosity in sharing his good fortune and talents with his students helped establish many of this country's fine medical lineages and led to the formation of some of the more important medical and intellectual institutions, many of which stand tall even today. ■

Anthony S. Patton '58 is a retired thoracic and vascular surgeon whose career was centered at Salem Hospital in Massachusetts.

IMAGE: COURTESY OF THE HARVARD MEDICAL LIBRARY IN THE FRANCIS A. COUNTWAY LIBRARY OF MEDICINE

Cold Calling

JANET REGIER '81 HATES WINTER. BUT THE SELF-DESCRIBED "outdoors unenthusiast" wouldn't take back a single moment of her Antarctic experience—not the igloo-building; not the ritual touching of the post staked at the South Pole; not the altitude sickness, the bulky gear, or the hat that gave her an uncanny resemblance to Marge Simpson; and especially not the sushi, eaten polar style, fresh from beneath the ice.

"One day I was taken to the laboratory of a scientist who studies fish blood for its antifreeze qualities," Regier recalls. "He had fed a winch under the Ross Ice Shelf and pulled up a huge Mawson cod. After tagging the fish, he served up, in the corrugated metal shack that housed his laboratory, fresh cod cheeks with chardonnay. They were delicious."

Regier's job brought her to that shack on the world's largest ice shelf in the height of the Antarctic summer in 2002. As the medical director of the National Science Foundation's health unit in Arlington, Virginia, she evaluates scientists and staff for their fitness for the extreme environments of the organization's polar program.

Her journey to Antarctica helped her understand the medical capabilities available at McMurdo Station, the main scientific base there, and experience the conditions firsthand. "After my trip," Regier says, "I began interpreting the mission-readiness criteria in much stricter fashion, especially when making evaluations of cardiovascular and endocrinological fitness."

She encounters tough cases that fall neither within nor without the polar program's guidelines. She worried, for example, about one scientist whom she'd approved for the assignment despite his earlier kidney transplant. Although she had wrestled with her original decision to clear him for duty at the Pole, Regier was reassured by her observations of the man on-site. "After seeing him in action outdoors," she said, "I didn't hesitate to approve him for the following year."

Regier discovered that healing takes longer at the Pole. "A laceration doesn't always anneal because it's so cold there," she says. "Sometimes you have to use superglue to coax it along." Dental fillings fall out. And other nuisances, such as a hangnail or any ordinarily minor threat to physical comfort, can quickly escalate to obsessions.

"The two days I was outside at snow school I couldn't find my mug," Regier says. "And all I could think about was if I just had my mug, I could wrap my hands around it and be warmer. We always try to alleviate pain, so when we can't, we perseverate on it. Such fixations can sour the whole experience if you let them."

The nearly 1,100 people stationed at McMurdo include not only scientists peering at ice cores, sea stars, and the stars above, but also the cooks, electricians, carpenters, and computer technicians who keep the base running. Regier evaluates and advises some of them, too, before they head south. "Many accidents happen because of the ice," she says. But slicing skin off a knuckle while peeling potatoes or losing one's grip on a hammer can also result when the cold stiffens digits and limbs.

"We employ many physical therapists who teach the workers to stretch before going on duty, sort of like a morning yoga class," Regier says. "The workers grumbled about this at first, but stretching has definitely reduced the rate of accidents."

Health care gets complicated at the Pole, she adds. "After February 25, it becomes logistically impossible to extract people from the base for about six months. That's why the 20 people or so who overwinter at the Pole each year are required to submit to more rigorous fitness evaluations. The added scrutiny includes a gallbladder ultrasound to check for stones or sludge and, for female researchers, a pregnancy test.

And yet no amount of clinical screening can prevent every health emergency. While working at McMurdo, Regier witnessed a telemedicine consultation with specialists at the University of Texas Medical Branch in Galveston. The clinic's physicians sought help with the case of a young man who had contracted viral pericarditis. Fortunately, the patient's pericardial effusion resolved, eliminating the need for off-continent medical transport.

A Desert Isle

Regier was surprised at the clinic's decidedly low-tech appearance despite its high-tech telemedicine, skilled physicians, and state-of-the-art decompression chamber for research divers. "The beds look like something out of *M*A*S*H*," she says, "with pulleys for traction and huge, nearly obsolete oxygen tanks."

But the lack of delicate equipment makes sense in a place where conditions are often harsh. Because Antarctica is a desert, water is rationed; people at the Pole

BED OF ICE: Janet Regier spent time at snow school near the South Pole, cutting blocks of ice from a glacier to build her night's shelter, an igloo.

muskox looks down like that and makes a noise, it's not good. I pedaled away as fast as I could."

Regier notes that many of those working in the Arctic also work in the Antarctic, switching Poles when the nights grow longer than the days. They become specialists in extreme environments and perhaps addicted to so much daylight. Regier says they jokingly describe themselves as "bipolar."

March of the Scientists

With 2007–08 marking the International Polar Year—the 50th anniversary of the

Many of those working in the Arctic also work in the Antarctic, switching Poles when the nights grow longer than the days. They become specialists in extreme environments and jokingly describe themselves as "bipolar."

may shower only once every week or two. Ironically, Regier says, fire also poses a major concern despite all that ice. So the scientists and others joined forces to create a volunteer fire brigade.

Beyond the base, closer to the Pole, conditions become even more extreme. Regier spent two days in snow school getting survival lessons in case of catastrophe. She learned to make an igloo, for example, by cutting ice blocks with an ice saw.

She also experienced altitude sickness, a common affliction at the Pole, which sits some 9,000 feet above sea level. A three-hour flight in a cargo plane across the TransAntarctic Mountains took Regier to the Pole, without any chance to acclimate. During her two days there, she suffered severe headaches. She now regularly screens patients for a history of high-altitude pulmonary or cerebral edemas, knowing that a person who has experienced it once has a 50 percent chance of a repeat bout.

Yet the geography also penetrates the gray matter in ways that seem to ease headaches. "It's incredibly beautiful in Antarctica, an icy Shangri-la," Regier says. "Everything is north of you. The real world feels far away. You think differently there."

Close Encounters

After living briefly 75 degrees south of the equator, Regier headed for an island 75 degrees north of that line—Greenland. Her May 2005 visit seemed practically balmy after the South Pole. "We had beautiful, long, sunshiny days," she says. "It was 50 degrees the day I arrived."

The highlight of her experience there was an encounter with local wildlife. "I'd taken a mountain bike up to Russell Glacier," Regier says, "and on the descent I spotted a muskox—looking like a small woolly mammoth, so hairy you could hardly see his eyes—on a hill, staring down. I had read that when a

global decision to use the Poles for peaceful rather than military purposes—it seems appropriate that Regier will be returning to the Antarctic next spring. But this time she'll travel to the peninsula just off the tip of South America known as the "Banana Belt."

Its relative warmth allows cruise ships to ferry tourists there to watch Adelie and Emperor penguins frolic on the icebergs. Regier's ship, however, won't be a luxury liner but a research vessel or an icebreaker. She'll be considering the particular hazards on board the ship and, once she's on the peninsula, she'll be evaluating the health unit at the base there, where 60 people work and live. But on that visit she also hopes to turn tourist for a few moments, to seek out some waddling, flightless birds on her own. ■

Janice O'Leary is assistant editor of the Harvard Medical Alumni Bulletin, *a comfortable 42 degrees north of the equator.*

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NEW KID ON THE BLOCK: The latest member of the patient simulation family at Harvard Medical School can cry, wet, and, in response to oxygen deprivation, turn blue.

PHOTO: CHRISTOPHER HARTING